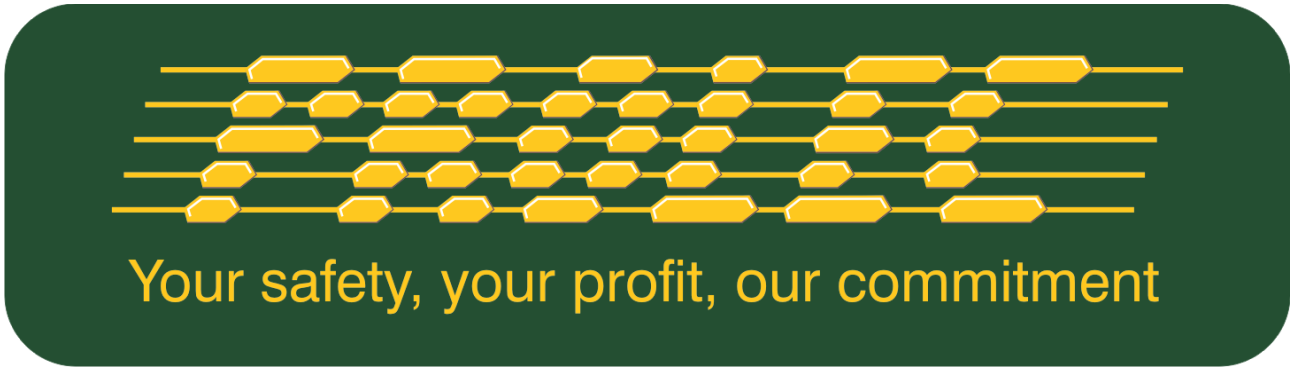
562600-000, Issue1.0, March 2014

PMERail Ultra

Rated Capacity Controller

Machine Envelope Controller

Operators Manual



This guide describes operation of the

PROLEC PME LIFTING AND MACHINE ENVELOPE SAFETY SYSTEM FOR

CONSTRUCTION PLANT

Model covered :	PART No.	MODEL Ref
	PMERail Ultra	PMERail Ultra - RCC / MEC SYSTEM

PMERail Ultra RCI system has been designed for compliance with RIS-1530-PLT Issue 4 and NR MDL/004 ISSUE 2

IMPORTANT : Before use, check the Engineering Acceptance certification and machine documentation to confirm if the Rated Capacity Controller, Adjacent Line Open and Overhead Line Equipment limitations that may exist within the use of the machine and / or the PMERail Ultra system.

Prolec supports a nationwide dealer network. Warranty claims, service work, technical information and spare parts are available by contacting :

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Nuffield Industrial Estate	E-mail	service@prolec.co.uk
Poole Dorset BH17 0GB		

DURING NORMAL OPERATION THE SAFE WORKING LOAD OF A CRANE SHOULD NOT BE EXCEEDED. THEREFORE THE WARNING OF OVERLOAD SHOULD NOT BE USED AS A NORMAL OPERATING FACILITY. IT SHOULD BE NOTED THAT CERTAIN STATUTORY REQUIREMENTS DO NOT PERMIT THE SAFE WORKING LOAD TO BE EXCEEDED EXCEPT FOR THE PURPOSE OF TESTING.

THIS RATED CAPACITY CONTROLLER (RCC) IS NOT SUITABLE FOR USE IN EXPLOSIVE ATMOSPHERES. ADJUSTMENT BY UNAUTHORISED PERSONS WILL INVALIDATE ANY WARRANTY OR CERTIFICATION SUPPLIED. IF A PROBLEM ARISES WHICH CANNOT BE RECTIFIED USING THIS GUIDE, AUTHORISED SERVICE SHOULD BE SOUGHT.

THIS DEVICE IS CERTIFIED TO MEET CURRENT UK & EC SAFETY REGULATIONS FOR LIFTING OPERATIONS.

Any alterations or modifications to machine components which affect this system and any system component failure must be reported to Prolec Ltd or via the machine convertor/ service agreement holder. This manual must be kept with the product and be passed on to any subsequent user of the product.

Whilst every effort has been made to ensure the accuracy of the information supplied in this manual, Prolec Ltd cannot be held responsible for any errors or omissions.

Manufacturers original instructions.

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1 Use of this Document

This user guide is intended for persons familiar with the use of construction plant undertaking lifting operations.

WARNING denotes information about particular risks which may be generated by certain applications, by using certain fittings, and about additional protective measures which are necessary for such applications.

Caution, care, risk situation

HAZARD Actions that can lead to serious injury or death

2 Notices

Adjustment by unauthorised persons will invalidate any warranty or certification supplied. If an error condition is displayed which cannot be rectified using this guide, halt any operation, seek authorised service immediately and do not continue operation until the fault has been remedied.

3 System Identification

The PMERail Ultra system provides two primary safety functions

1. Lifting Stability
2. Machine Envelope Monitoring

Both safety functions are achieved through real time monitoring some or all of the machine's moving parts (booms, other articulations, turret etc) and its environment (ground pitch and inclination, load etc) and actively determining the safety of the current operation where appropriate limits have been set.

The Lifting Stability function falls into a single class

- Rated Capacity Controllers (RCC) prevent instability when the machine is involved in lifting operations. This is achieved by hydraulically stopping unsafe movements of the machine which could cause the machine to tip.

The Machine Envelope Monitoring function has a single class

- Machine envelope controllers (MEC) prevent movements that would bring parts of the machine into hazardous areas, most notably height restrictions when working under Overhead Line Equipment and in an Adjacent Line Open situation.

4 Operating and Hazard Situation Recommendations

Operating Recommendations

When using envelope monitoring:

- When setting height or slew restrictions, make sure any implement/tool attached is in its least favourable position
- Check for correct operation once the restriction has been set
- Reduce operating speed
- Do not move the equipment quickly when close to a restriction
- Do not operate the machine in a reckless manor
- Do not travel with a restriction set
- Reset the slew restriction if the machine is relocated

When operating the machine as a crane:

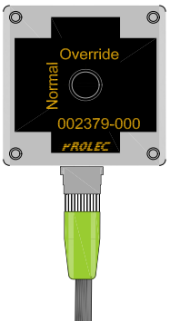
- Ensure Lift Mode is selected during lifting operations
- Operate the machine at a sensible speed
- Take extra care when travelling with a load attached
- Do not operate the machine in a reckless manner

Hazard Situation Recommendations

In a limit hazard state:

- Return the control levers to neutral once a limit has been reached if appropriate
- Operate the machine at a slow speed
- Do not travel

4.1 RCC - MEC Override



The system is fitted with a key operated master override switch. To access the master override switch, a tamper detection device must be broken and the operation of this switch will be automatically logged. Turning the switch to the override position will allow normal operation of any of the hydraulic services controlled by PMERAIL regardless of safety status. When the system is in override, the external alarms will stay active, the amber and blue lamps will be off and the red LED will flash along with an ‘In Override’ message will on the display.
The override key switch should only be used if the system is not operational due to a fault and the machine needs to be moved due to its location presenting a hazard.
The override status will be recorded in the system data logger.

5 Operating Instructions

This machine is equipped with an electronic movement limiter and rated capacity indicator. With responsible use this device will provide reliable protection for both personnel and plant.
This unit records data on the machines operation.
When setting a limit ensure any attached tool is in its least favourable position.
Check for correct operation once a limit has been set.
Operate the machine at a responsible speed.
Release the control levers if a limit is reached.
Ensure Lift Mode is selected during lifting operations.
Operate the machine in a reckless manner.
Raise the equipment quickly when close to a limit.
Travel over rough terrain when at or near a limit.
Exceed the machine's SWL during normal operation.
Failure to observe these guidelines can result in serious injury or death. Only use this equipment if fully familiar with its operation.
Press any button to continue
PROLEC

5.1 Power Up

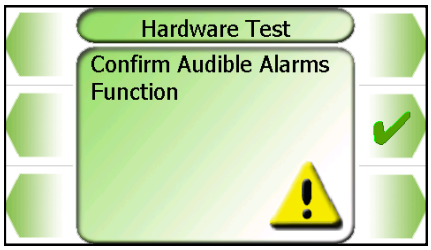
PMERail automatically powers up when the machines ignition is switched on. The in-cab display incorporates a 4.3” high resolution LCD display and is controlled with three buttons at each side. Three status LEDs and an internal alarm provide further information. The display is secured to the machine using a flexible ball mounting allowing easy adjustment for personal viewing preference.

Upon starting up:

1. All LEDs will flash, the internal display alarm and the external alarm will sound momentarily.

2. A safety warning message will be displayed as shown above, acknowledge its contents by pressing any button.

2. To comply with the Network Rail RIS-1530-PLT issue 4 standard, the external alarm will operate. To confirm this, press the GREEN TICK button.



3. The system can be configured to work with the on-board Operator Database and will prompt for a valid and in date operators pass code. See section 5.3 for further details.

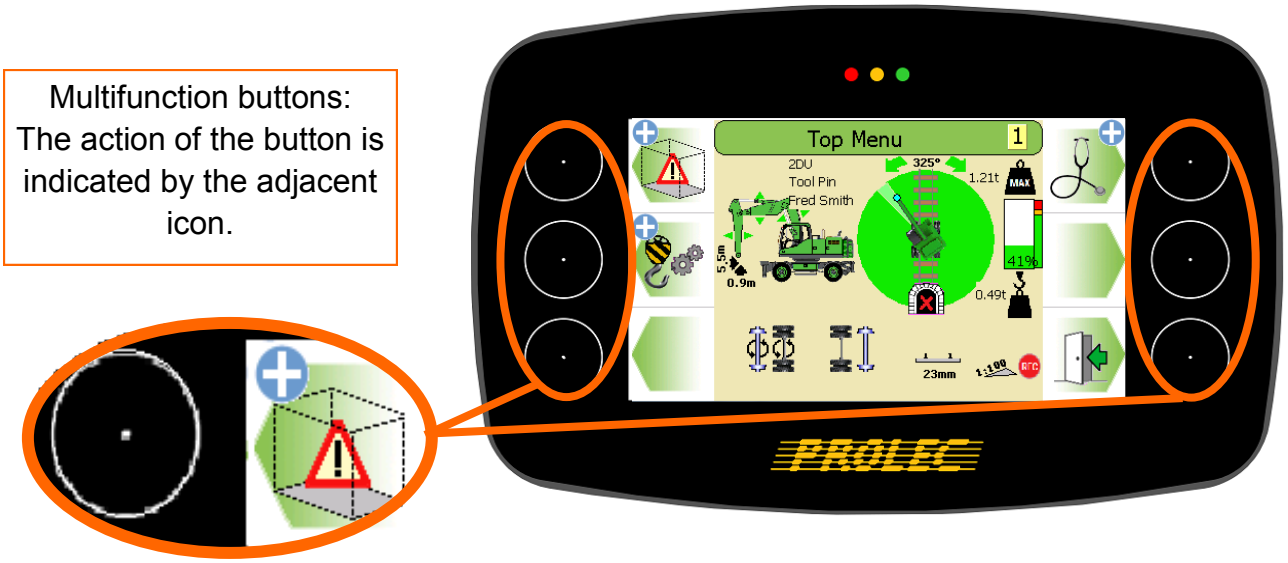
The system will automatically set a height limit of 3.5m: this will occur on first deployment of the rail bogies or if they are deployed when the system is started.

If the RED LED remains lit, a fault has been detected, halt any operation, seek authorised service immediately and do not continue operation until the fault has been remedied.

5.2 Using the Display

The display is operated by using the buttons adjacent to a function icon. The buttons can open a sub menu, turn a function ON or OFF, set a value and toggle through multiple screens. No one button has a single function. The button icon will turn black/purple when the button has been activated. Note that the image of the machine on the left is fixed and does not follow the movement of the machine. Functions maybe restricted to a supervisor level, see section 5.5.

Multifunction buttons: The action of the button is indicated by the adjacent icon.



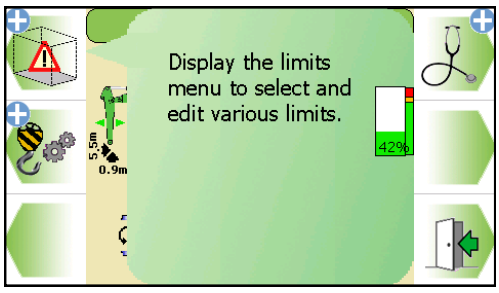
A secondary symbol can appear in the top left corner of an icon, these mean :

The plus symbol indicates a sub menu will be opened if selected.

The cycle symbol indicates that multiple features are available.

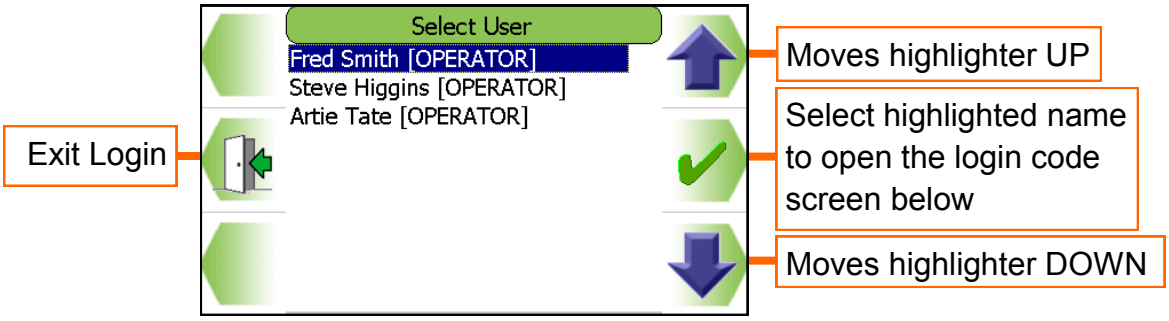
The on/off symbols indicate if a feature is ON or OFF. Red is ON and grey is OFF.

Help is available for each button. To access help, push and hold the relevant button for three seconds. The help screen can be cleared by pressing any button. PME is still active when displaying help messages, if Lifting Mode is active and or an envelope limit is set alarms or warning conditions will be indicated.

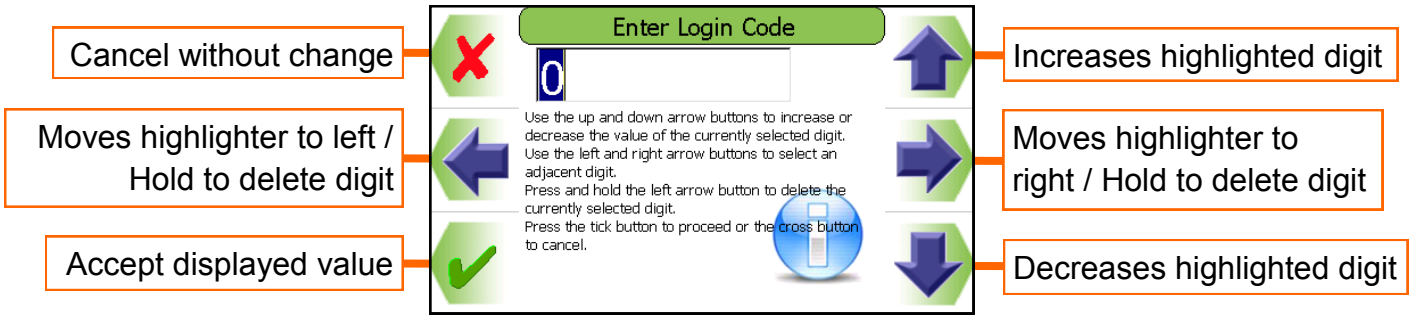


5.3 User Login

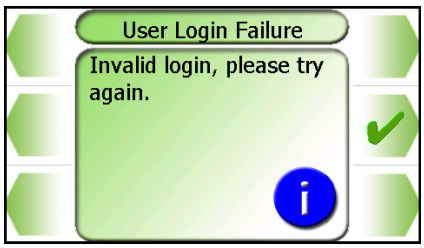
If PMERAIL has been configured to work with the Operator Database, the system will prompt for a user login pass code. Select the user name required and the login code screen will appear.



Using the arrow buttons enter a valid pass code. The previous pass code digits will be replaced with a star as the code is entered. Press the GREEN TICK button to confirm the login pass code. If a valid pass code is entered the system will commence normal operation.


Enter Login Code
0
Use the up and down arrow buttons to increase or decrease the value of the currently selected digit.
Use the left and right arrow buttons to select an adjacent digit.
Press and hold the left arrow button to delete the currently selected digit.
Press the tick button to proceed or the cross button to cancel.
Cancel without change
Moves highlighter to left / Hold to delete digit
Accept displayed value
Increases highlighted digit
Moves highlighter to right / Hold to delete digit
Decreases highlighted digit

If an incorrect login code is entered, a failure screen will be displayed. Press the GREEN TICK button to return to the Select User screen.



5.4 User Logout

If a user is logged in, they can select the logout screen by holding an exit key button down for three seconds.

Once log off has been confirmed, the login screen will be automatically displayed. Press the RED CROSS button to stay logged in, the screen will return to that previously shown.

5.5 Supervisor Key Switch

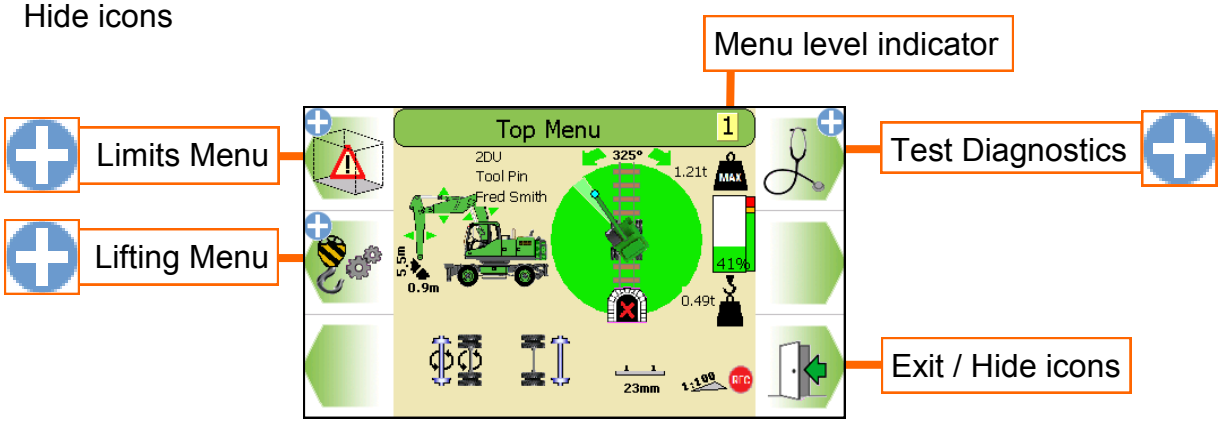
The supervisor keyswitch must be in the **SET** position to access the lift mode functions, see section 7.7 and envelope limiting functions, see section 8. Wherever the supervisor icon is seen in this guide, the supervisor keyswitch must be operated to gain entry to that function.

6 Top Menu

The Top Menu screen allows access to all the system functions. If the icons are hidden press any button to reveal. To return to the Top Menu from a sub menu press the EXIT button.

Top Menu button functions:

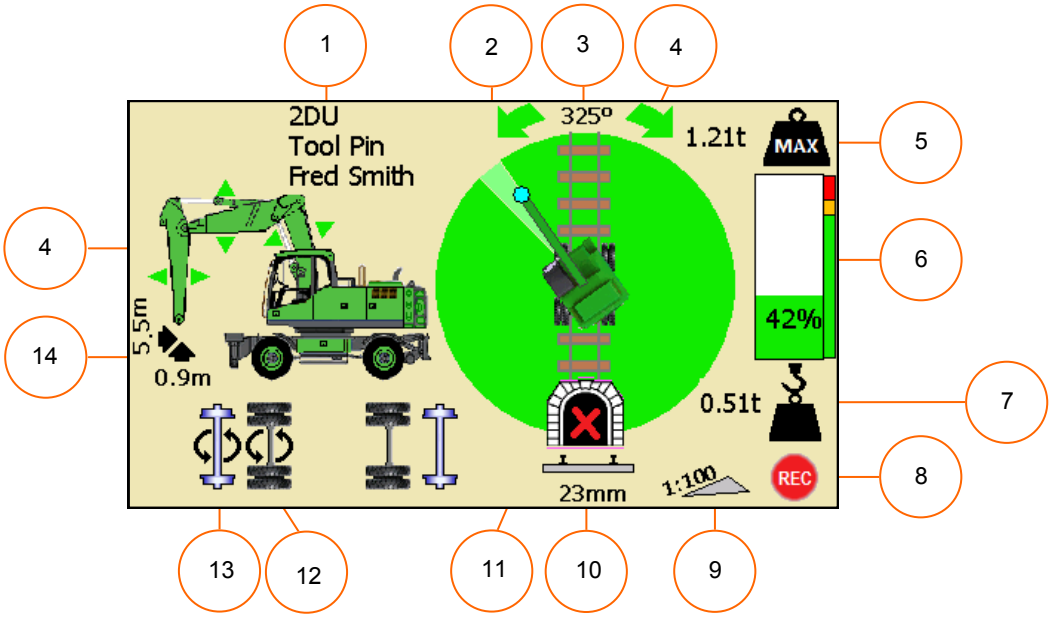
- Limits menu
- Lifting menu
- Test Diagnostics
- Hide icons



7 Rated Capacity Controller

7.1 Introduction

PMERail has been designed to meet Network Rail requirements for the provision of rated capacity indicators and ensures that the maximum lifting capacity over the range of a machine working envelope can be utilised. The system will default to Lifting Mode when started up or when the bogies are deployed. See section 4 for operating advice when using construction plant as a crane. The blue lamp will indicate that Lifting Mode is active.



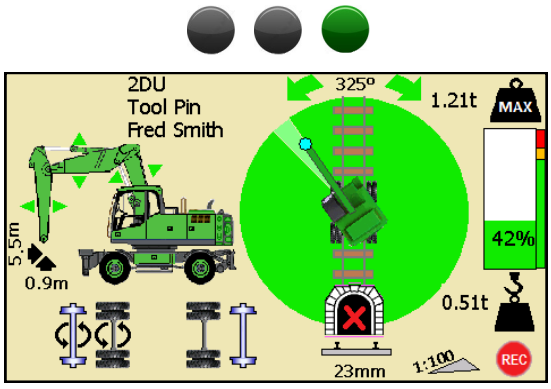
1.	Duty Indicator	Appendix 1
	Lifting point	Section 7.11
	Login name	Section 5.3
2.	Sector Indicator	Appendix 1
3.	Slew Angle Indicator	Section 8.3.1
4.	Safe Direction Indicator	Section 8.3.1
5.	Maximum Safe Working Load	Section 7
6.	SWL percentage	Section 7
7.	Load On Hook	Section 7
8.	Logging Indicator	Section 18
9.	Gradient Indicator	Appendix 1
10.	Cant Indicator	Appendix 1
11.	In Gauge Indicator	Section 7.13
12.	Rail Bogie Indicator	Appendix 1
13.	Axle Lock Inhibit Status	Appendix 1, 2
14.	Lifting point Height/Radius	Section

The SWL as displayed assumes that the load is suspended directly below the lifting point. The weight of the tool or tools, if fitted, (e.g. Bucket , quick hitch etc) are included in the SWL and LOH values if they were taken into consideration when the system was calibrated. The bucket cylinder and control linkage is assumed to be present.

Any alterations or modifications to machine components which affect the RCI must be reported to Prolec Ltd or via the machine convertor/service agreement holder.

7.2 Operation within the Safe Working Load

With Lifting Mode active, the Load on Hook, current lifting point, current duty, lifting point radius and the maximum safe working load for that radius are shown.



If the load is less than 95% of the maximum safe working load

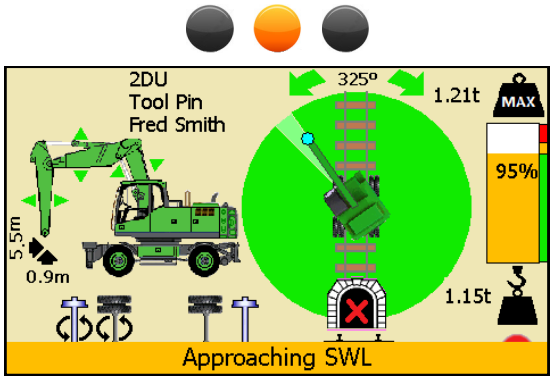
- The load capacity indicator will be green
- The green LED will be lit

7.3 Barred Duties, warnings and Interlocks

A duty can be denied entry by locking certain machine hydraulic services if there is insufficient lifting capacity in that duty. For Lift and carry duties only, no motion cut will occur. Travel and axle lock interlocks can operate automatically to ensure the stability of the machine during use, see Appendix 2.

7.4 Approach to Overload

With Lifting Mode active, if the load is greater than 95% of the maximum safe working load, the system will warn the machine is approaching the lifting capacity at the current height and radius.



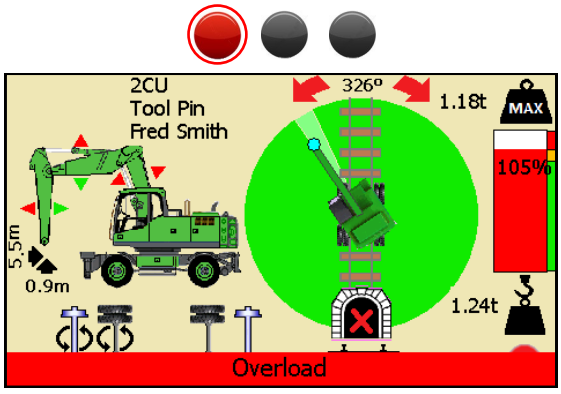
If the load is greater than 95% of the maximum safe working load.

- The load capacity indicator will be amber
- The amber LED will be lit
- The internal alarm will sound
- The message shown here will be displayed.

In the event of an approach to overload or an overload condition, the lifting point should only be moved in a direction that increases the safe working load. See section 4 for further information.

7.5 Stability Overload Control

Where an overload condition occurs the machine hydraulics will be locked to prevent any further dangerous movements. Only those movements that allow safer operation remain active, all slewing is prevented. The radius cannot be increased and the load cannot be raised. The internal and external alarms will sound in conjunction with visual indicators on the display.

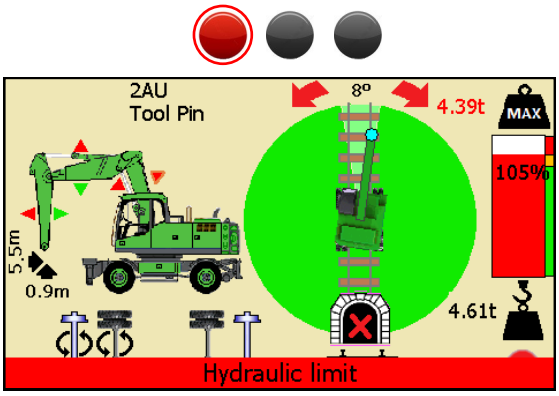


If the load is greater than 105% of the maximum safe working load

- The load capacity indicator will be red
- The red LED will flash
- The internal and external alarm will sound
- The message shown here will be displayed
- Motion control of the machine will operate, motion cut is indicated by RED arrows, safe motion is indicated by GREEN arrows

7.5.1 Hydraulic Limitation Control

The system will cut motion to the appropriate articulation in a hydraulic limit state via internal and external alarms in conjunction with visual indicators on the display. If a particular lift is limited by hydraulic capacity rather than stability, the maximum safe working load will be shown in **RED**. Hydraulic limitation is more likely to occur at short radii.



*Where an overload condition occurs the machine hydraulics will be locked to prevent any further dangerous movements. Only those movements that allow safer operation remain active. The radius cannot be increased and the load cannot be raised.

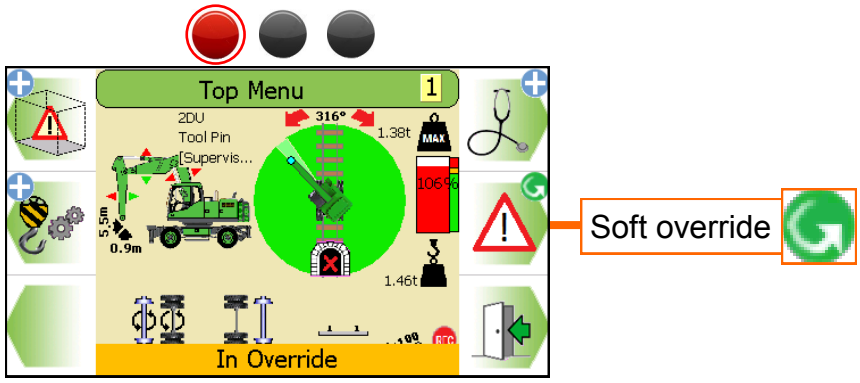
After three seconds a soft override will become available if the supervisor key-switch is in the **SET** position, see sections 5.5 and 7.6.1.

In the event of an approach to overload or an overload condition, the lifting point should only be moved in a direction that increases the safe working load. See section 4 for further information.

7.6 Overload / Hydraulic Limitation Control Override

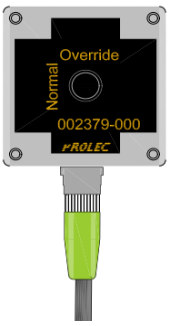
7.6.1 Soft Override

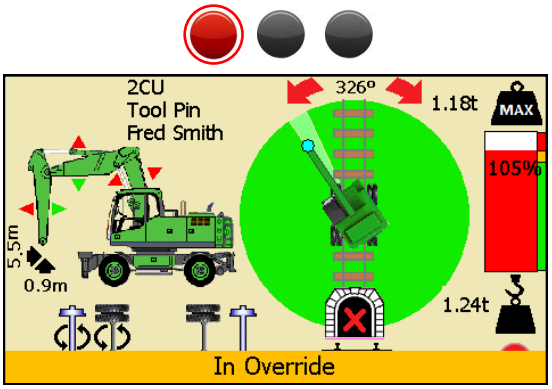
Three seconds after overload has occurred, a soft override button will become available in the top menu with the supervisor keyswitch is in the **SET** position, see sections 5.5 and 7.6.1. If the soft override function is utilised, the machine hydraulics will be re-enabled. However, the external alarm will stay active, the internal red LED will flash, the blue lamp / Amber lamp will be switched off and an In Override message will appear on the display. Once the alarm condition has been corrected the system will automatically revert to normal operation.



7.6.2 Master Override key Switch

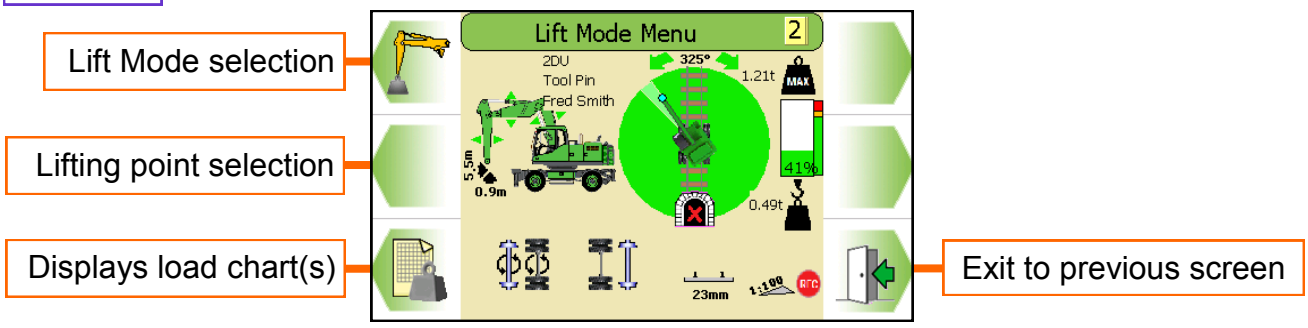
The system is fitted with a key operated Master override switch. Turning the switch to the override position will allow normal operation of the hydraulic services controlled by PMERail regardless of safety status. When the system is in override, the external alarms will stay active, the internal red LED will flash, the blue lamp and Amber lamp will be switched off and an In Override message will appear on the display. The system will automatically return to normal operation after 30 minutes (default value), See section 4.1 for further details.





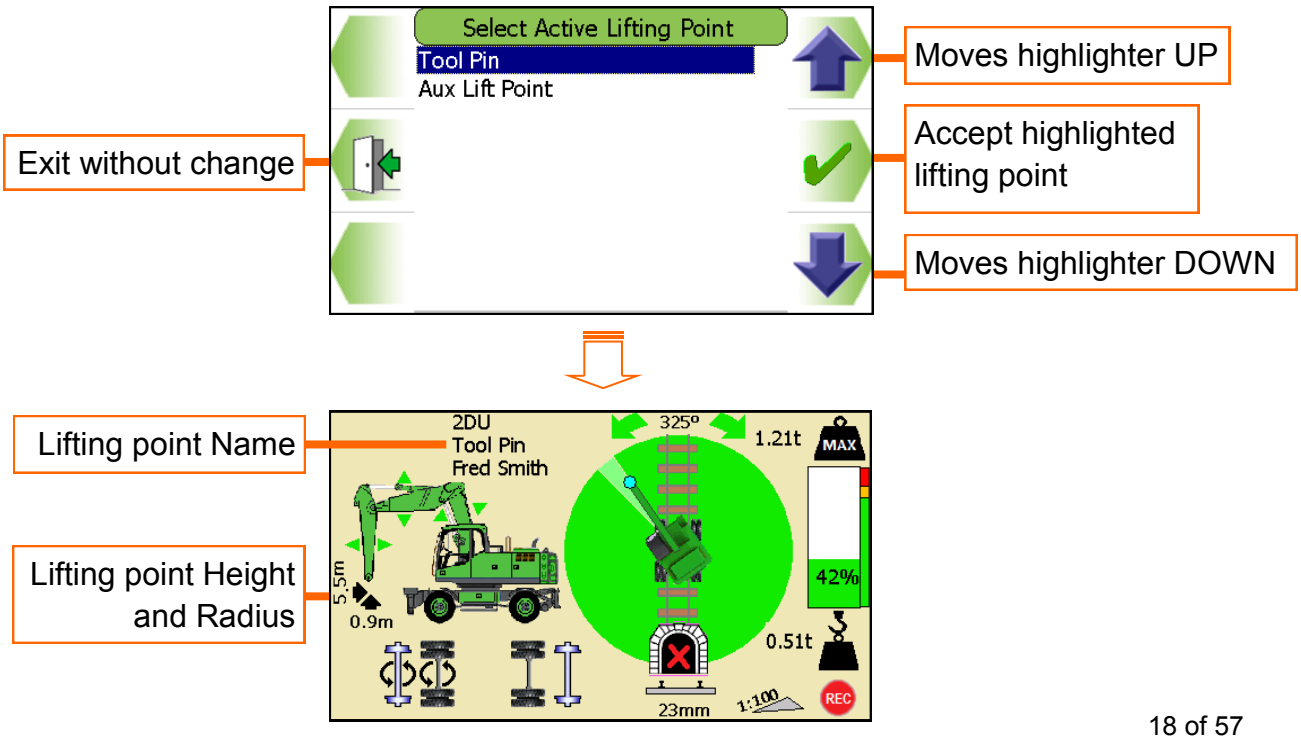
7.7 Lift Mode Menu

The Lifting Mode menu has various features which may be available if configured at installation. If only one lifting point has been calibrated, the lifting point button will not be displayed.



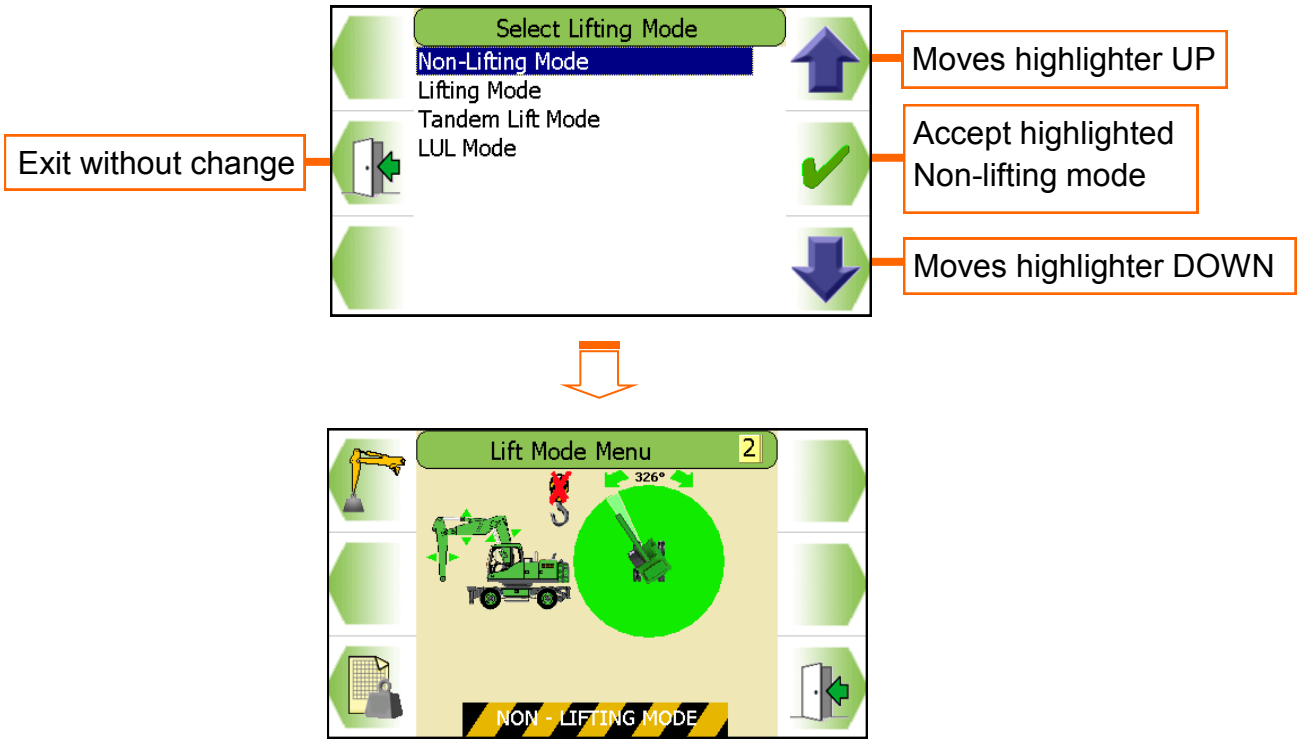
7.7.1 Lifting Point Selection

PMERail can be configured for more than one lifting point. If more than one lifting point has been calibrated, they will be manually selected via the lifting point selection screen shown below. Use the arrow buttons to select the required lifting point and confirm using the GREEN TICK button. The Supervisor keyswitch must be in the **SET** position to access this feature, see section 5.5 for further information. Example lifting points are shown in the listing. Always refer to the manufacturer/convertor instructions regarding positioning of the lifting point during lifting operations. Altering the lifting point will not affect the current duty selected, see Appendix 1.

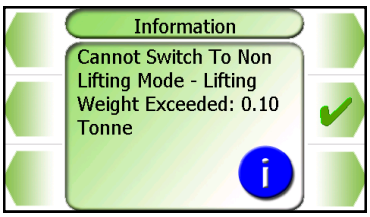


7.7.2 Lifting Mode - Non Lifting Mode

When the machine is not being used for lifting operations it can be put into 'Non Lifting Mode'. This is available from the Lifting Mode screen.
When in Non Lifting Mode, the system still monitors all machine activity and safety status but will NOT warn of overload or impose any form of overload hydraulic control, the system will continue to monitor back stability conditions.
In this mode, the blue lamp will be off, indicating that the Lifting Mode functionality is NOT active. Non Lifting mode will auto exit if the rail bogie status changes. Envelope Limit monitoring will remain active if any limit has been set.
The Supervisor keyswitch must be in the **SET** position to access this feature if it is enabled, see section 5.5 for further information.



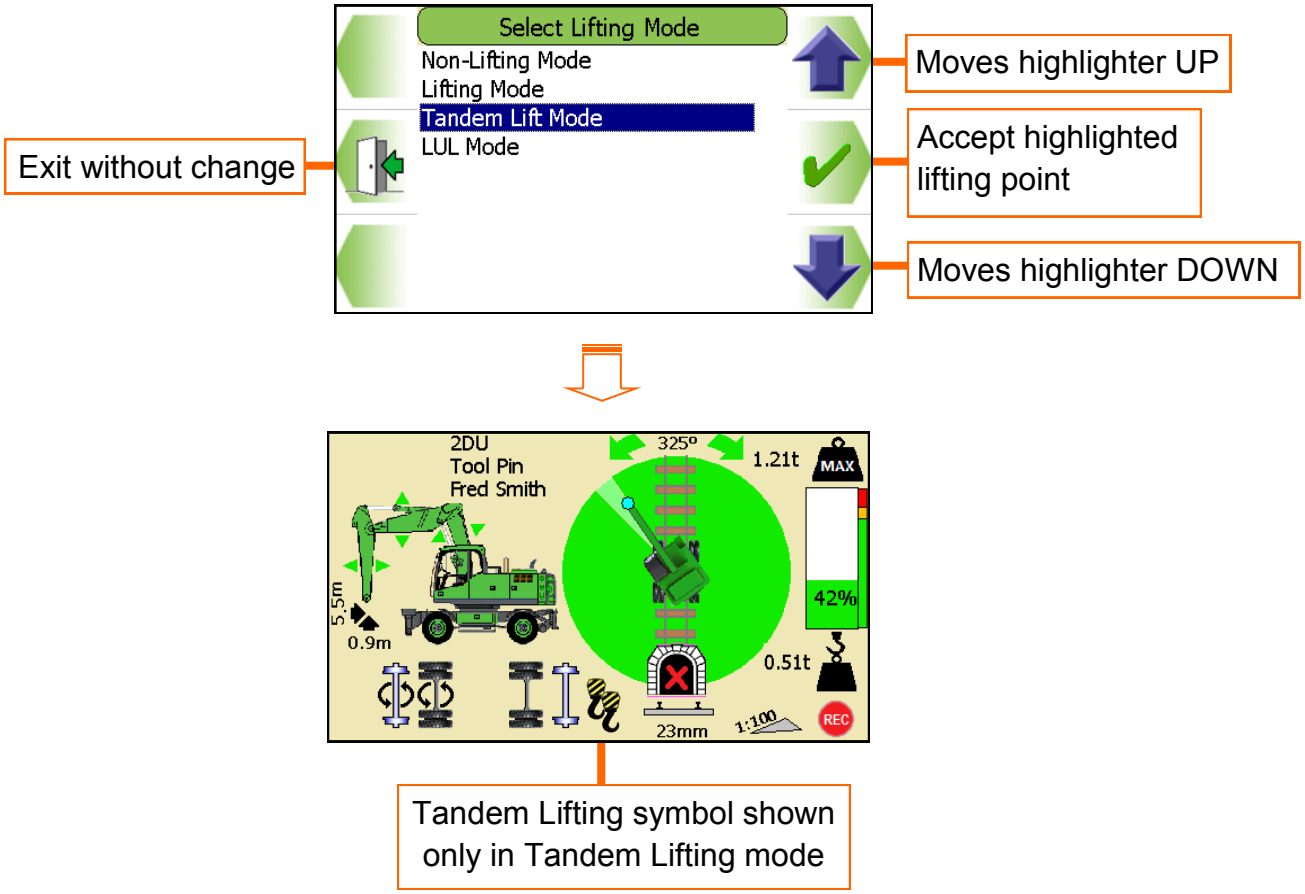
Lifting mode cannot be deactivated if the LOH value exceeds a predefined weight, press the GREEN TICK to acknowledge and return to lifting mode.



When in Non Lifting Mode, the screen states NON-LIFTING MODE on the hazard warning tape, lifting operations should not be attempted in this state. The blue lamp will be off.

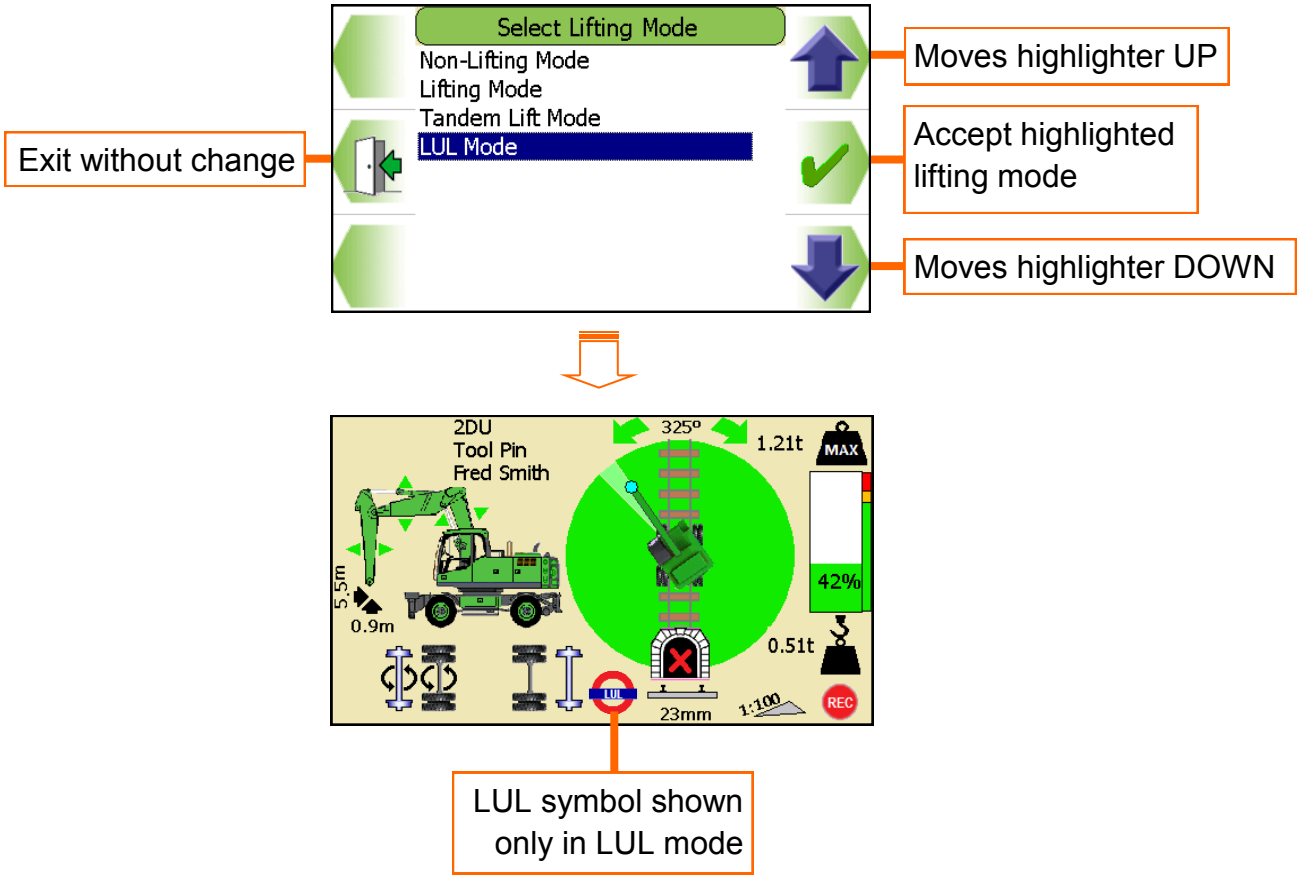
7.7.3 Tandem Lifting Mode

PMERAIL can be configured for tandem lifting. If tandem lifting has been calibrated, it will be manually selected via the lift Mode menu. Once selected, the blue lamp will flash to indicate the system is in tandem lifting mode. The Supervisor keyswitch must be positioned in the **SET** position to select or cancel this feature, see section 5.5 for further details.



7.7.4 LUL Lifting Mode

PMERail can be configured for LUL mode. If LUL has been calibrated, it will be manually selected via the lift Mode menu. The Supervisor keyswitch must be positioned in the **SET** position to select or cancel this feature, see section 5.5 for further details.



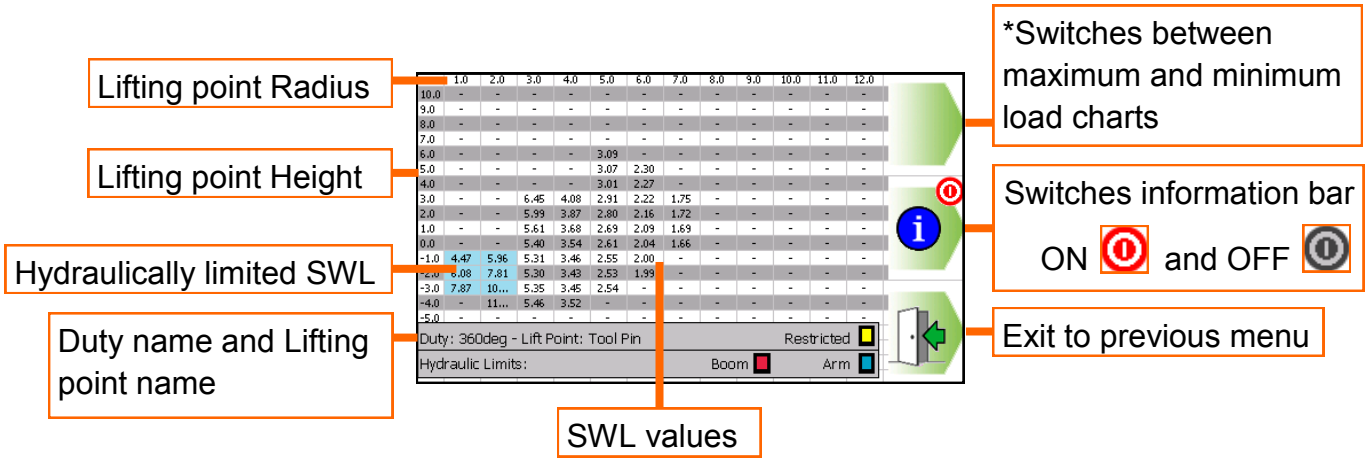
7.8 Lifting Duty Safety Factors

The maximum safe working load will appear at the top right of the screen and is stated in TONNES. This maximum load is for the currently active lifting duty / lifting point. Lifting duties are automatically selected using a combination of chassis status, axle lock status, slew angle, chassis angle and switch inputs. Altering the duty will not affect the current lifting point selected, see section 7.7.1.
If a particular lift is limited by hydraulic capacity (87% of Main Relief Valve pressure) rather than stability, the maximum safe working load will be shown in **RED**. The maximum load is stated as a percentage of the 'tipping load' and in a standard installation will conform to the table shown below :

Lifting regime	Safety factor	Notes
Road	75%	All road lifting duties regardless of chassis angles and oscillating axle lock status.
Network Rail	67%	Lift and carry - oscillating axle unlocked
Network Rail	75% or 90%	Static lift - oscillating axle locked. The maximum load will be either 90% of a load necessary to totally unload a single rail wheel, or 75% of a load necessary to totally unload two rail wheels - whichever is the lowest.
Tandem Lifting	67% of the current safety factor	If 'Tandem Lifting' mode is selected all duties will revert to this safety factor regardless of bogie position, chassis angle or oscillating axle lock status.
LUL	75%	All LUL lifting duties regardless of chassis angles and oscillating axle lock status.

7.9 Load Chart Menu

PME can display the load chart for the currently selected lifting duty and lifting point. *If the machine is equipped with a hydraulically adjustable boom, both maximum and minimum charts will be available via this button. Hydraulically adjustable booms allow the machine to reach the same point in space (i.e. height and radius combination) with a variety of different equipment angles. The minimum loads shown refer to the least favourable angle combination. When load charts are being displayed, machine safety status is still monitored.

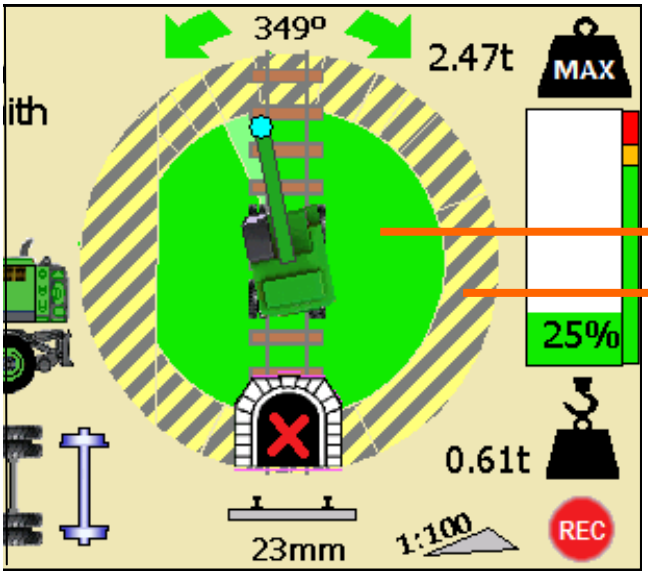


If a particular lift is limited by hydraulic capacity rather than stability, the SWL value will be in a coloured box - RED for boom, GREEN for articulated boom and BLUE for ARM. A lifting point can be restricted to a maximum value, if this is the case the SWL value will be in a YELLOW box.

The display will automatically revert back the top menu screen after ten seconds if a button has not been pressed.

7.10 Safe Working Area Indication

Safe working area indication displays in real time the where a load can be safely moved using the plan view. This feature will be available if it has been activated at calibration.



With Safe Working Indication ON:

The Green area indicates the safe zone

The Hatched area indicates the hazard zone

Any green area is safe and any hatched area is unsafe. The hatched area uses the LOH value and the SWL value for all slew based duties to calculate the green and hatched area. If a Virtual slew wall (section 8.2) has been set then this limit will be incorporated into the hatched area.

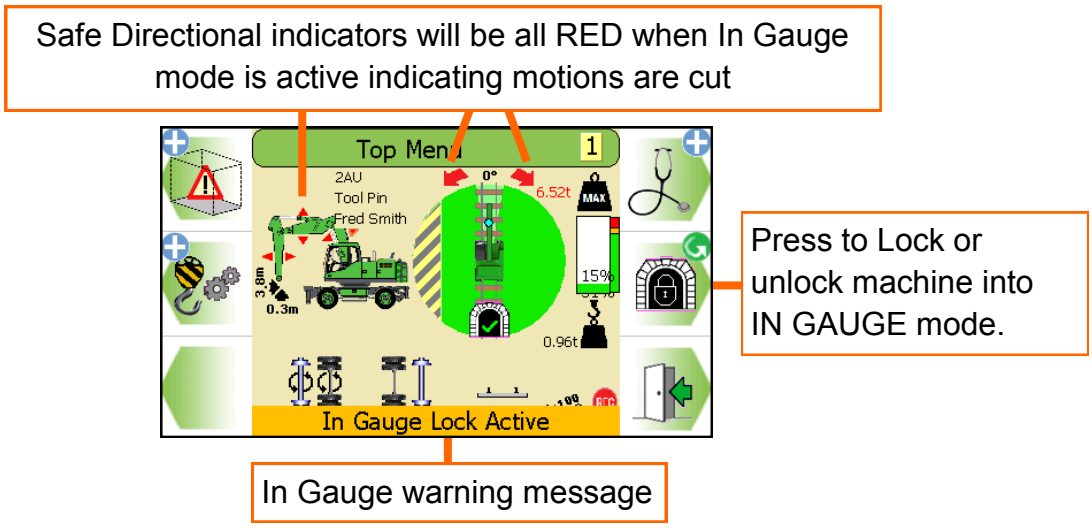
This feature does not indicate duties automatically switched using proximity switches such as extending sections or stabilisers.

7.11 In Gauge Indicator

If the machine is on-rail, within the Wa6 gauge and the oscillating axle is unlocked, the In Gauge icon will turn from a RED CROSS to a GREEN TICK and the In Gauge button will appear in the top menu, press to motion to cut all services for safe travel.

The GREEN TICK symbol indicates that the right and left corners of the counterweight, bucket pin and the highest point of the machine are within the W6a gauge dimensions. The In gauge button will now appear in the top menu, press to lock slew left / right, boom up and down, artic up and down and arm in and out. Press again to unlock these services

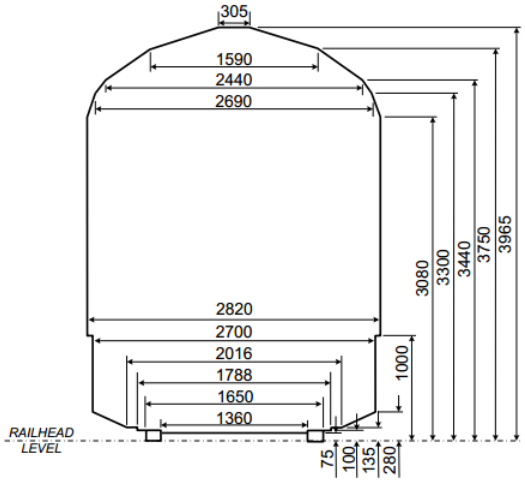
The RED CROSS symbol indicates that the machine is outside of the gauge dimensions.



WARNING The system is unaware of any additional implements / tools, see section 8.4.

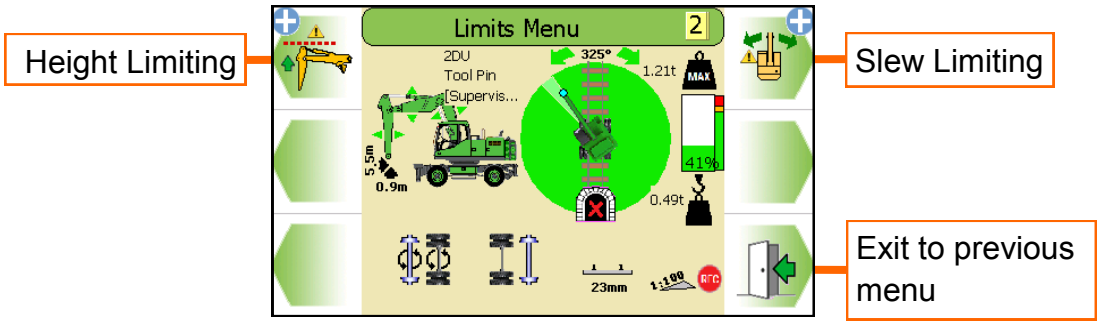
Machines with front and rear oscillating axles will indicate In Gauge when either the front or rear axles are unlocked or when both are unlocked. In gauge indication will not be available if both (front and rear) axles are locked.

Wa6 Gauge dimensions are shown opposite.



8 Envelope Monitoring

PMERail Ultra is configured for Machine Envelope Control (MEC) only. MEC will warn and prevent equipment motion in a limit state. MEC is achieved by interacting with the machines hydraulics, this allows motion to be cut to any section of equipment that has reached a restriction but allow other sections to operate unhindered unless they too reach the set restriction, see section 8.4 for monitored points on the machine. PMERail is NOT aware of any attachment fitted, therefore make sure is in its least favourable position when setting any limit.



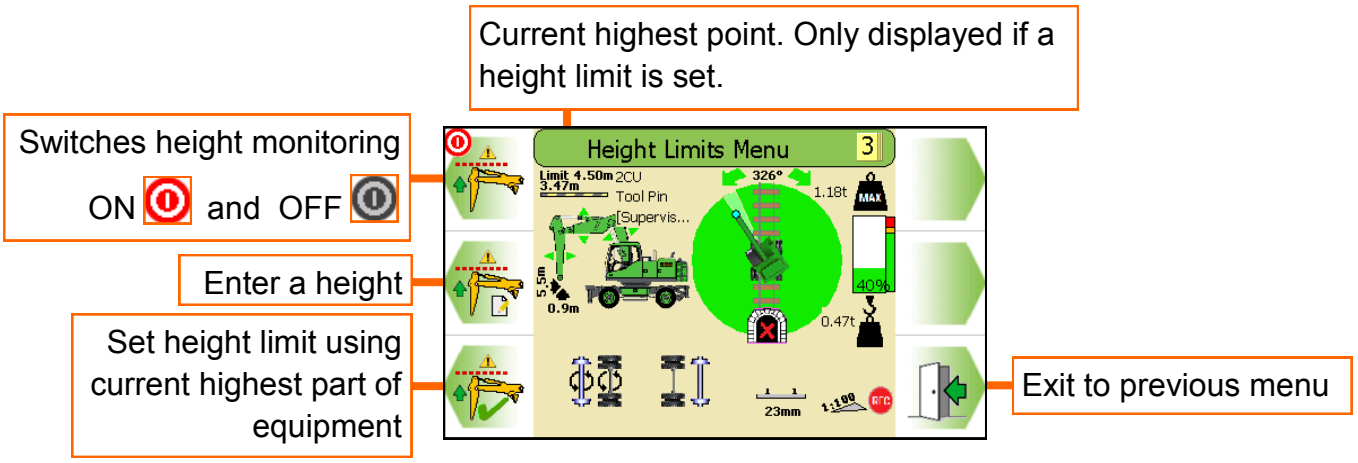
8.1 PMERail Ultra Height Limitation

PMERail Ultra complies with RIS-1530-PLT Issue 4 height limiting requirements. Therefore a default height limit of 3.5m will activate automatically on start up if the bogies are deployed or on their first deployment. Any height limit previously set will be replaced.

Care should be taken to test that the limit is set correctly. Observe the operational limitations given in section 4.

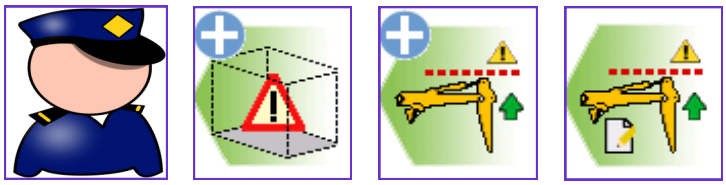
8.1.1 Height Limit Menu

A height limit can be set by entering a known height on the keypad or by manually moving the machine to the desired limit.

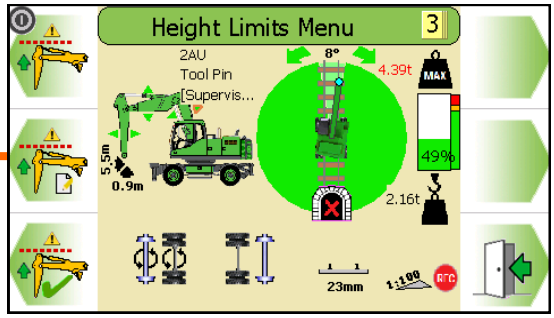


Using the height Limits Menu, the height limit can be switched ON and OFF (a Confirm Operation screen will be displayed, see sections 8.1.2 to enter a known height and section 8.1.3 for setting the limit by moving the machine.

8.1.2 Height Limit Setting - Known Height

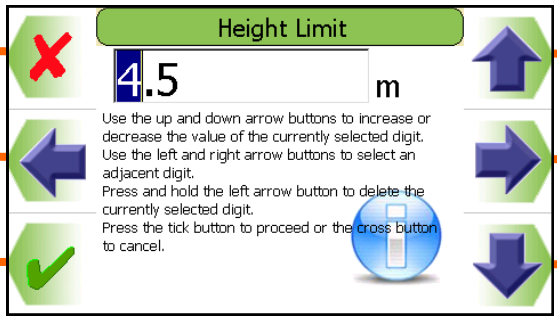


A known limit can be entered into the display:



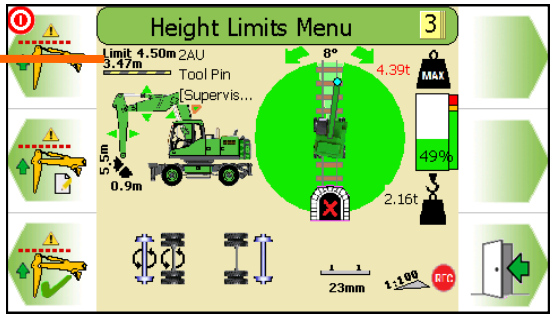
Step One

Press the 'Enter a value' button


Height Limit
4.5
m
Use the up and down arrow buttons to increase or decrease the value of the currently selected digit.
Use the left and right arrow buttons to select an adjacent digit.
Press and hold the left arrow button to delete the currently selected digit.
Press the tick button to proceed or the cross button to cancel.
Cancel without change
Moves highlighter to left / Hold to delete digit
Accept displayed value
Increases highlighted digit
Moves highlighter to right / Hold to delete digit
Decreases highlighted digit

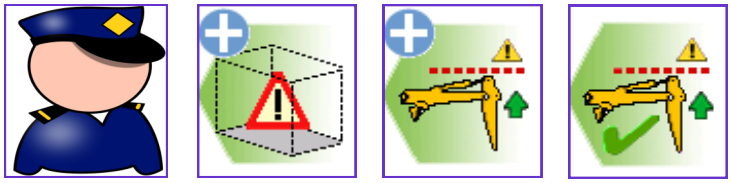
Step Two

Set a limit and press Green TICK to accept.

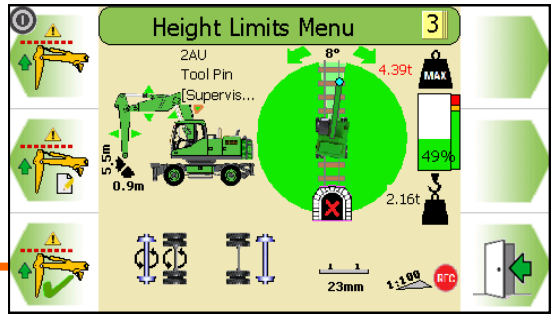


Once a height limit set, the internal alarm will sound and the RED LED will light if the equipment exceeds the current limit. Always check that the current limit activates at the set point. The restriction cannot be deactivated if in the alarm state. Observe the operational limitations given in section 4.

8.1.3 Height Limit Setting - Using Current Highest Point



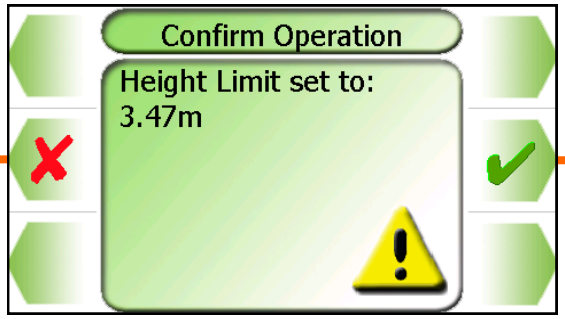
The highest point of the machine can be used to create a height limit:



Move equipment to required height limit and press this button

Step One

Move the equipment to the required height limit and press the ‘Set using highest point of equipment’ button



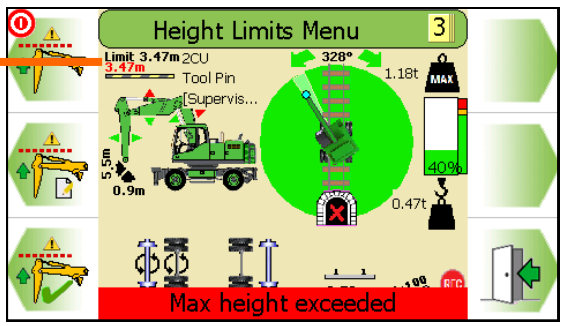
Exit without change

Accept the value shown

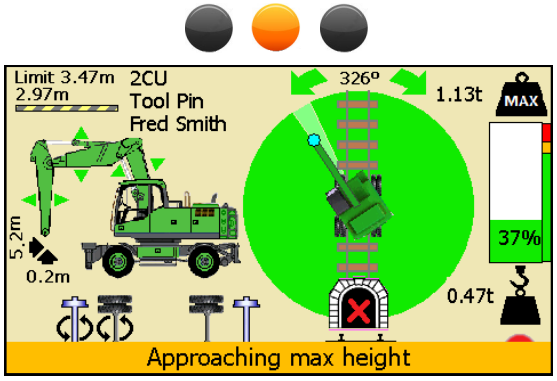
Step Two

Check the limit and press Green TICK to accept.

Height limit shown here



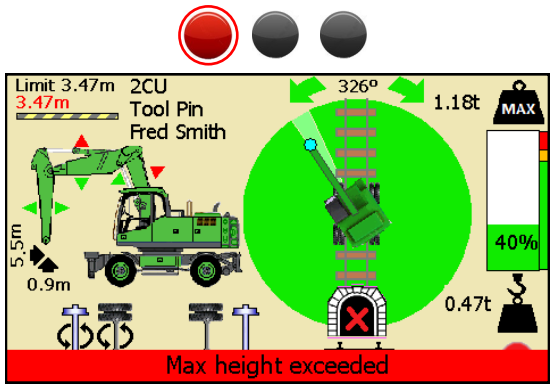
8.1.4 Machine Envelope Controller (MEC) - Height



If any of the equipment enters the approach limit*

- The amber LED will be lit
- The internal alarm will sound
- The message shown here will be displayed.

MEC systems will cut motion to any section of equipment that has reached a limit but allow other sections to operate unhindered unless they too reach the set limit.



- The safe directional indicators will be red. Unsafe motion will be locked and is indicated by RED arrows/triangles, safe motion is indicated by GREEN arrows/ triangles
- The red LED will flash
- The internal alarm will sound

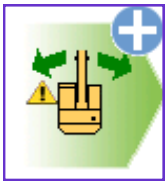
*The approach limit is configurable at point of calibration, check system operation before commencing work.

See sections 4.1 and 7.6 for hydraulic override details.

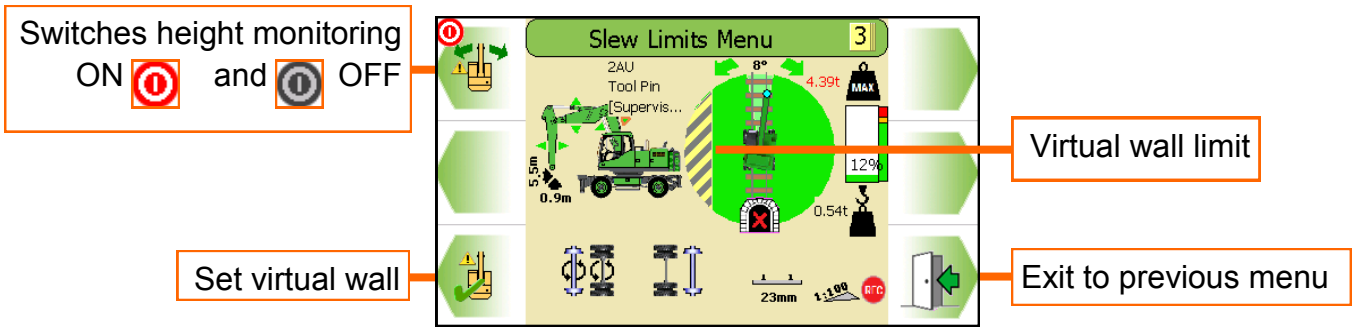
Once a height limit set, the internal alarm will sound and the RED LED will light if the equipment exceeds the current limit. Always check that the current limit activates at the set point. The restriction cannot be deactivated if in the alarm state. Observe the operational limitations given in section 4.

8.2 Slew Limit

8.2.1 Slew Limits Menu



A virtual wall slew limit can be set entering a known distance on the keypad or by moving the virtual wall on the screen using the arrow buttons to the desired limit. With a slew limit set, the screen will display a hatched area on the plan view.

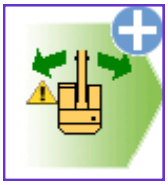


A limit can be switched ON and OFF (a Confirm Operation screen will be displayed, see sections 8.2.3 to enter a known value and section 8.2.4 for setting the limit by manually moving the limit via the display.

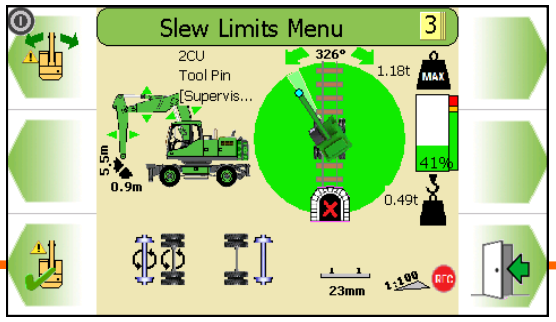
Use with an offset boom: if a slew limit is active and the offset boom is moved from straight ahead, the confirmation message shown here will appear. Press the red button to confirm that you are aware that the slew limit will be cancelled. This action is recorded in the event data log.

See section 8.2.2/3 for virtual wall setup and section 8.2.4.1 PMERail Ultra Virtual Wall Limitation

8.2.2 Virtual Wall Limit Setting - Dial in a value



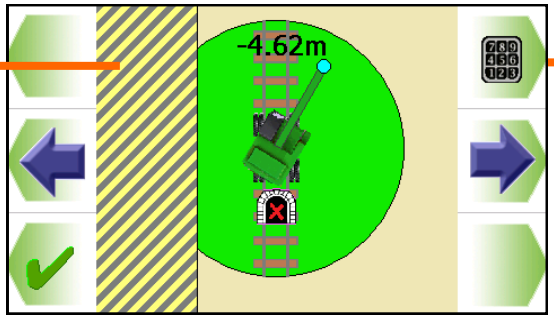
A virtual wall can be set on either side of the machine to a desired distance by either dialling in a value.
The value displayed is measured from the centre of the machine.
Do not travel once a slew limit has been set.



Set up a virtual wall

Exit without change

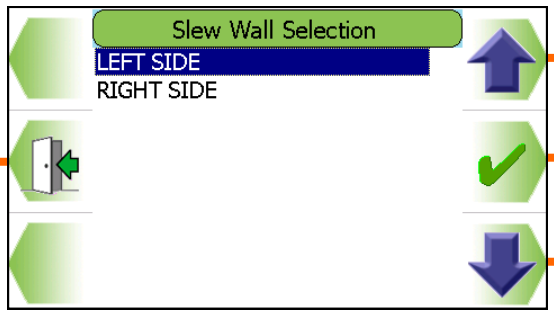
Step One
Press the Set up a virtual wall button



Virtual wall limit

Keypad button

Step two
Press the Keypad button



Exit without change

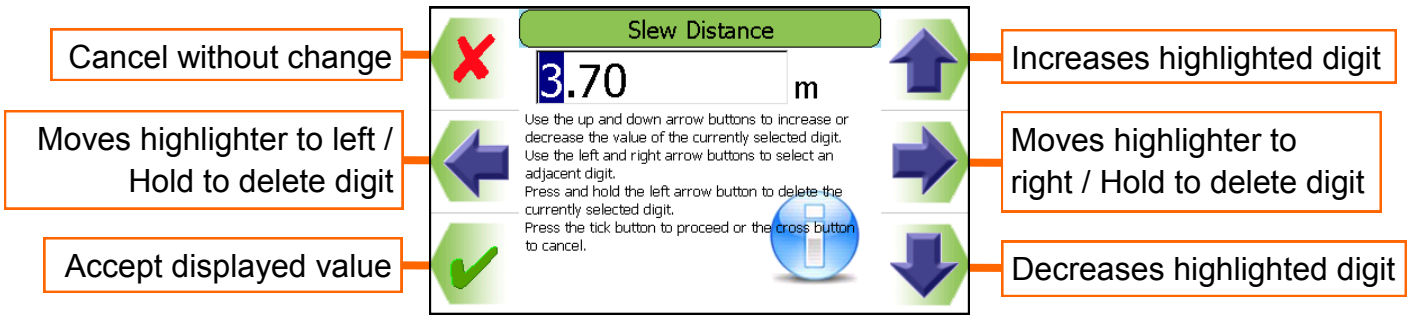
Moves highlighter UP

Accept highlighted side

Moves highlighter DOWN

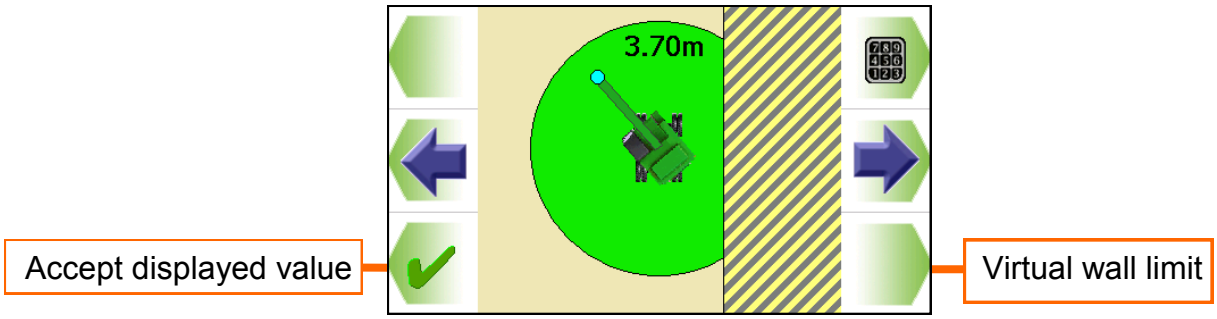
Step three
Select a side to set the virtual wall on

Continued on next page


Cancel without change
Moves highlighter to left / Hold to delete digit
Accept displayed value
Slew Distance
3.70
m
Use the up and down arrow buttons to increase or decrease the value of the currently selected digit.
Use the left and right arrow buttons to select an adjacent digit.
Press and hold the left arrow button to delete the currently selected digit.
Press the tick button to proceed or the cross button to cancel.
Increases highlighted digit
Moves highlighter to right / Hold to delete digit
Decreases highlighted digit

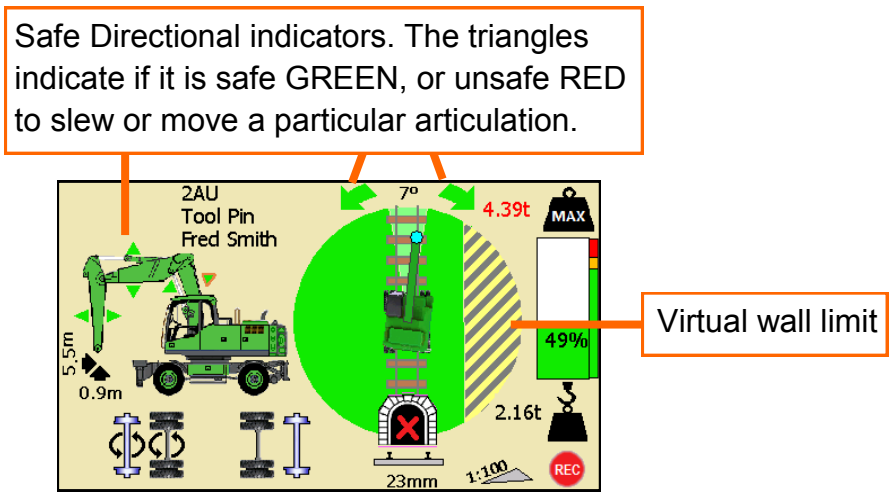
Step four

Use the UP and DOWN arrows to increase and decrease the highlighted number. Use the LEFT and RIGHT arrows to move the highlighter to the left and to the right. Press the GREEN TICK to accept the displayed value.



Step five

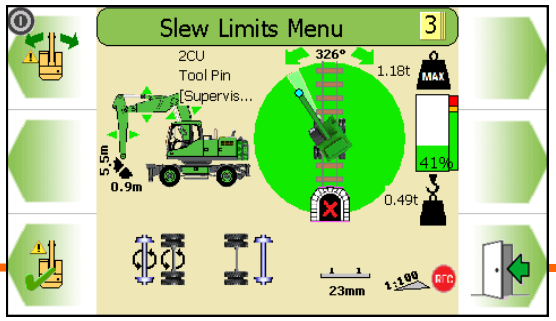
Ensure the virtual wall is set correctly before pressing the GREEN TICK to accept and use the limit displayed.



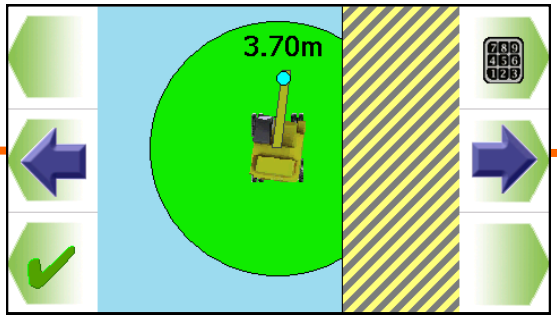
Once slew limits are set, the internal alarm will sound and the RED LED will light if the equipment exceeds the limit. Always check that the slew limit activates at the set point. The limit cannot be deactivated if in the alarm state. Observe the operational limitations given in section 4. Do not travel once a slew limit has been set.

8.2.3 Virtual Wall Limit Setting - Manually set a limit

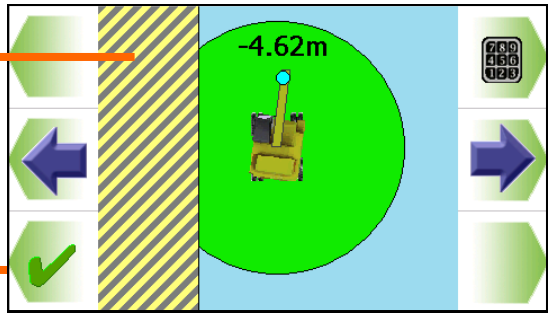
A virtual wall can be set on either side of the machine to a desired distance by using the directional arrows to manually move the limit.
The limit displayed is measured from the centre of the machine.
Do not travel once a slew limit has been set.



Step One
Press the Setup a virtual wall button

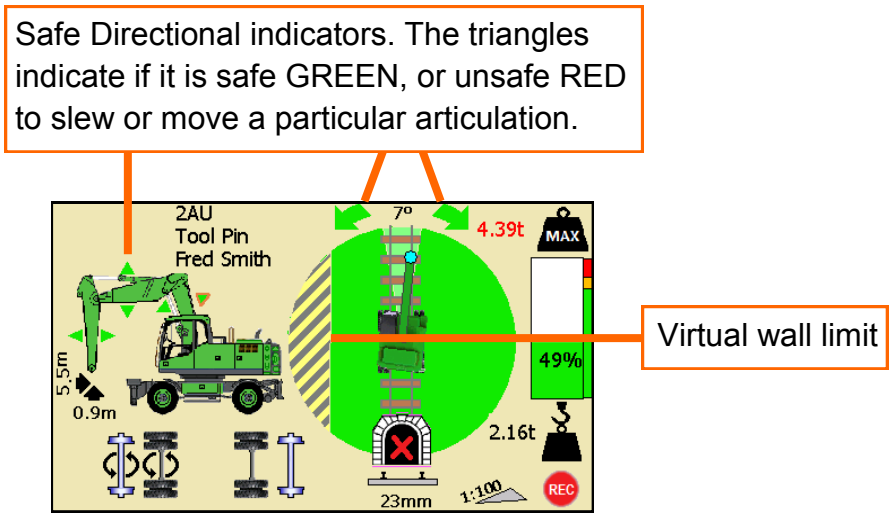


Step two
Use the Left and Right arrows to manually move the Virtual wall to the desired position.



Step three
Ensure the virtual wall is set correctly before pressing the GREEN TICK to accept and use the displayed value.

Continued on next page



The Virtual wall will be shown on the main screen.

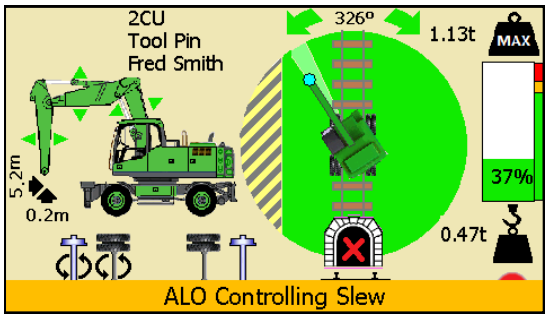
Once slew limits are set, the internal alarm will sound and the RED LED will light if the equipment exceeds the either limit. Always check that the slew limit activates at the set point. The limits cannot be de-activated if in the alarm state. Observe the operational limitations given in section 4. Do not travel once a slew limit has been set.

8.2.4 Machine Envelope Controller (MEC) - Virtual Wall PMERail Ultra

8.2.4.1 PMERail Ultra Virtual Wall Limitation Control

PMERail Ultra complies with NR MDL/004 ISSUE 2. slew limits requirements. Therefore with a virtual wall slew limit active, as in addition to standard slew limit function (see section 8.2.4.2) the system will:

- Activate an amber lamp to show a slew limit is active
- The slewing speed of the machine will be reduced to one of three possible states:
  - Linear speed at the tool point will be no greater than 2 m/s when MORE than 2m (default) away from the set limit.
  - Linear speed at the tool point will be no greater than 1 m/s when LESS than 2m (default) away from the set limit.
  - Linear speed at the tool point will be CONTROLLED by PMERail when LESS than 1m (default) away from the set limit. If the tool point reaches 1m (default) away from the limit, PMERail will:
    - Motion cut slew at 1m (default) from the limit to allow PMERail to take over slew control in the direction of slew travel only.
    - To move closer to the slew limit, the slew joystick must be returned to the neutral position then back towards the limit. The warning message show here will be displayed, linear speed at the tool point will be no greater than 1 m/s in this state.

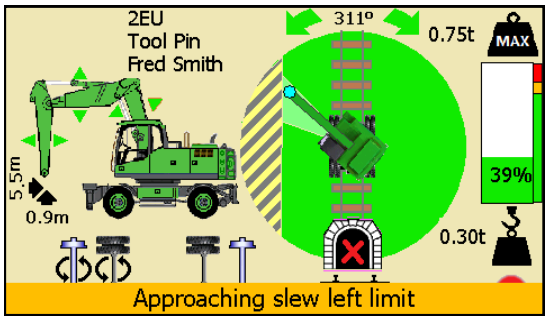


- At the limit, motion will be stopped.
- It will be possible to move away from a limit at anytime, the linear speed at the tool point speed will be increased back up to no greater than 2 m/s.
- The counterweight will not induce the 1m/s state even if it comes within 2m of the limit.

Care should be taken to test that the limit is set correctly. Observe the operational limitations given in section 4.

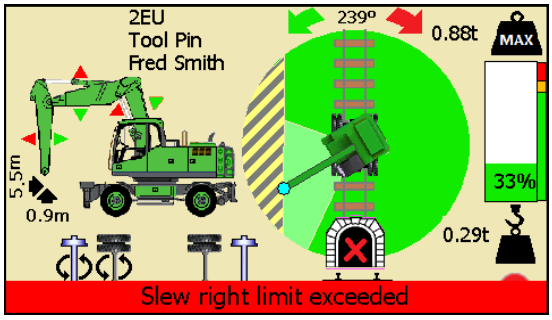
Once slew limits are set, the internal alarm will sound and the RED LED will light if the equipment exceeds the either limit. Always check that the slew limit activates at the set point. The limits cannot be deactivated if in the alarm state. Observe the operational limitations given in section 4. Do not travel once a slew limit has been set.

8.2.4.2 Machine Envelope Controller (MEC) - Virtual Wall



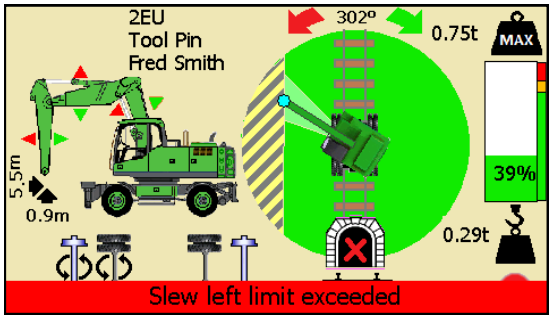
If any of the equipment enters the approach limit*

- The amber LED will be lit
- The internal alarm will sound
- The message shown here will be displayed.



MEC systems will cut motion to any section of equipment that has reached a limit but allow other sections to operate unhindered unless they too reach the set limit.

If the equipment reaches the limit, the appropriate motion will be controlled.



- The safe directional indicators will be red. Unsafe motion will be locked and is indicated by RED arrows/triangles, safe motion is indicated by GREEN arrows/ triangles
- The red LED will flash
- The internal alarm will sound

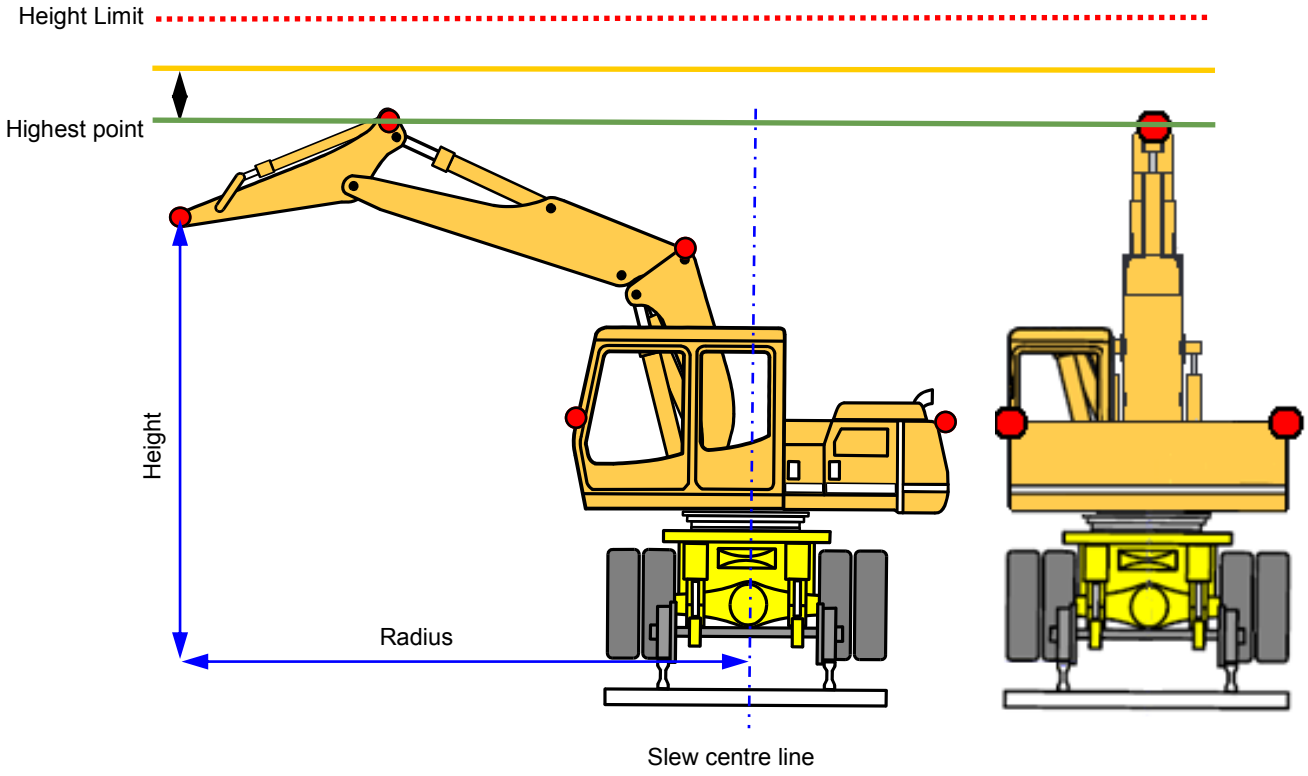
*The approach limit is configurable at point of calibration, check system operation before commencing work.

See sections 7.6 for hydraulic override details.

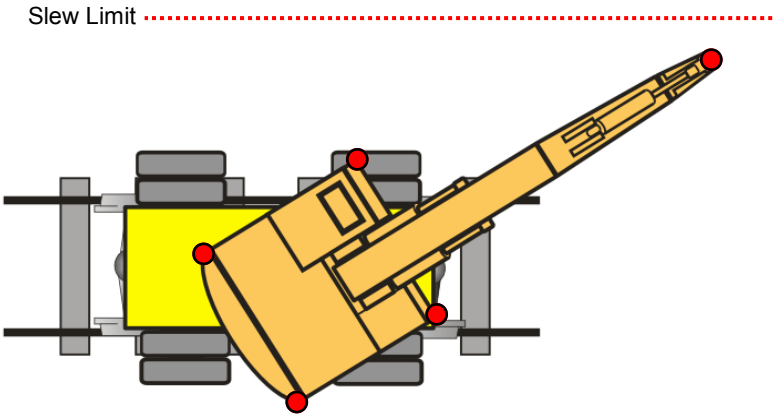
Once slew limits are set, the internal alarm will sound and the RED LED will light if the equipment exceeds the either limit. Always check that the slew limit activates at the set point. The limits cannot be de-activated if in the alarm state. Observe the operational limitations given in section 4. Do not travel once a slew limit has been set.

8.3 Equipment Position measurement

PMERail measures equipment pin positions using equipment mounted angle sensors. All positions are corrected for chassis pitch (rail gradient), roll (rail cant) and slew angle. The radius displayed on the operators screen represents the current lifting point and the height represents the tool pin height. Shown without hitch.



● = Equipment extremes measured by the system



◆ NB to account for extra equipment and pipework etc, both the bucket pin and arm ram pin can use an optional vertical safety ‘offset’ determined during RCI set-up and calibration.

9 System Messages

9.1 On Screen Safety Messages

Approaching max height	Highest point of equipment within *0.5m of set limit
Maximum height exceeded	Equipment has reached/exceeded set limit
ALO Controlling Slew	PMERail is controlling slew movement toward the slew limit
Approaching Slew limit	Equipment within *10 degrees or 0.5m of set limit
Slew Limit exceeded	Equipment has reached/exceeded set limit
Max Boom Angle Exceeded	Boom has reached/exceeded a set value
Lifting barred in next Duty	Insufficient lifting capacity in next duty
Lifting barred in this Duty	Cannot lift in this duty
Maximum working cant exceeded	Track cant exceeded limit (default = 180mm).
Maximum working gradient exceeded	Track gradient exceeded limit (default = 1 in 30).
Approaching canted duty	Insufficient lifting capacity in next duty (Lift and carry duties only) No motion cut will occur
Fully Extend/Retract Counterweight	Fully extend/retract counterweight
Offset boom is not straight	Offset boom not straight. System will automatically cancel any slew limit set, warning message must be acknowledged
Approaching SWL	95 percent of the maximum safe working load
Overload	105 percent of the maximum safe working load
Hydraulic Limit	Pressure in a ram/s is in excess of 87% of main relief valve pressure
In Override	Override has been activated (Soft override or master Key)
In Gauge Lock Active	In Gauge mode has been activated

*The approach limit is configurable at point of calibration, check system operation before

9.2 On Screen Component Error Messages

PMERail continuously monitors the presence and condition of it's system components. If any sensor, input, output, or other component fails, an error message will appear along the bottom of the display. In the event of a failure, ALL motion control relays will be operated, the cab mounted blue lamp will indicate that the RCI is NOT active, the display red LED will flash and the internal and external alarms will sound. Warning messages can appear on the screen at any time. They will automatically clear when the error condition has been rectified. Below is a summary of possible messages:

Sensor Broadcast Error ID 33	Boom Piston / Rod Pressure Sensor Error
Sensor Broadcast Error ID 32	Boom Angle Sensor Error
Sensor Broadcast Error ID 96	Artic Angle Sensor Error
Sensor Broadcast Error ID 64	Arm Angle Sensor Error
Sensor Broadcast Error ID 128	Hitch Angle Sensor Error
Sensor Broadcast Error ID 224	Cant Angle Sensor Error
Sensor Broadcast Error ID 192	Slew Angle Sensor Error
Sensor Broadcast Error ID 43XX	Safety Controller / I/O module 43XX (X denotes box ID)
Output Failure X - X	Output Failure on Safety Controller / I/O module X Output X (X denotes box ID and Input Number)
Unknown Duty	Incorrect Input Configuration/ slew position
Input Failure X - X	Input Failure on Safety Controller / I/O module X Output X(X denotes box ID and Input Number)
Override Keyswitch Failure	Override Keyswitch has been Damaged/ Disconnected
Override Timed out	Override feature has been enabled for X minutes (Default 30 minutes) and has been reset
Connector Tampering Detected	Beacon, Alarm, Override Keyswitch, Output/ Input Disconnected

9.3 On Screen ALO Component Error Messages

PMERail Max and Ultra continuously monitors the presence and condition of the ALO slew components. If any sensor, input, output, or other component fails, an error message will appear along the bottom of the display. In the event of a failure, ALL motion control relays will be operated, the cab mounted blue lamp will indicate that the RCI is NOT active, the display red LED will flash and the internal and external alarms will sound.

ALO CRC failure	EEprom config CRC failure
ALO CAN failure	Null Safety Controller pointer
ALO pilot failure	Failed to initialise CAN
ALO invalid S/C	Failed to initiate back drive controller class
ALO backdrive failure	Failed to initiate pilot/brake controller class
ALO slew CANopen failure	No slew CAN messages
ALO pitch/roll not detected	No dual axis CAN messages
ALO backdrive CANopen failure	No back drive controller CAN messages
ALO pilot CANopen failure	No pilot controller CAN messages
ALO left feedback error	Left controller feedback error > 10%
ALO right feedback failure	Right controller feedback error > 10%
ALO pilot feedback failure	Pilot controller feedback error > 10%
ALO brake feedback failure	Both joysticks active at once
ALO illegal joysticks	Left joystick input stuck low
ALO left joystick inactive error	Right joystick input stuck low
ALO right joystick inactive error	Left joystick input stuck high
ALO left joystick active error	Right joystick input stuck high
ALO right joystick active error	Left pressure switch input stuck low
ALO left pressure inactive error	Right pressure switch input stuck low
ALO right pressure inactive error	Left pressure switch input stuck high
ALO left pressure active error	Right pressure switch input stuck high
ALO right pressure active error	Failed to initialise axiomatic controller(s)
ALO controller failure	No/missing CAN messages from Safety Controller
ALO S/C not reporting	Brake controller feedback error > 10%
ALO slew DR	Slew dual redundant error

9.4 LED and Internal Alarm Warnings

The table below shows the state of the three LEDs on the display and the internal alarm with respect to system status.

LED and Internal Alarm status	System status
	Off
	Start up, Power Down
	Operational: System OK, no warnings, hazards, or errors
1 Hz	Warning: Approach to overload or envelope limit
Continuous	Hazard; Overload or breach of an envelope limit
	Maintenance: Engineering access active
8 Hz	Error: PME hardware/software error, or sensor failure

10 Daily Checks

See section 12 for test / diagnosis features. If an issue is discovered which cannot be rectified using this guide, halt any operation, seek authorised service immediately and do not continue operation until the fault has been remedied.

- Display - check for damage and correct operational
- Safety Controller - check for damage and correct operational
- Sensors and sensor cabling - check for damage
- Connectors - check for damage
- Alarm / Blue Lamp / Amber Lamp functionality
- Automatic Duty Selection
- Relays inputs and motion cuts
- Check Anti Tamper devices are secure on motion cut valves and master override keyswitch

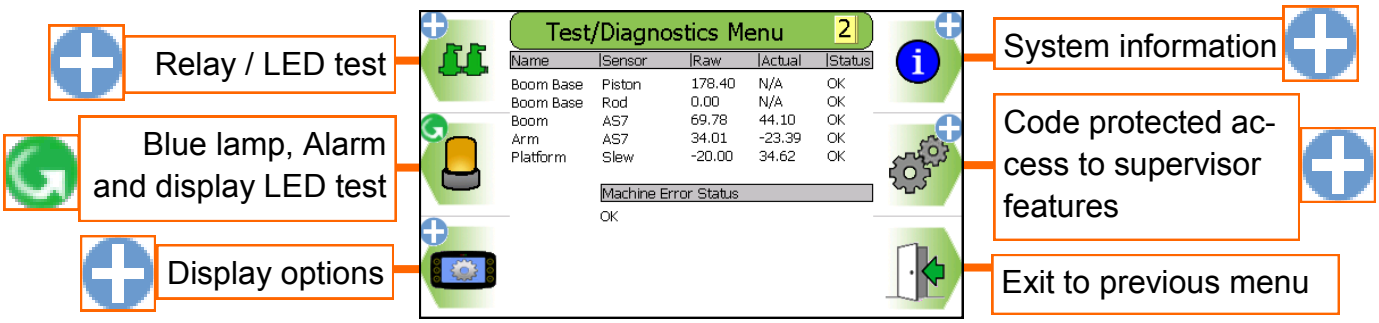
11 Repair

Once a repair has been carried out and tested, the following must be checked:

Required Checks	Section
Angle Sensor Check	12.2
Relays Check	12.1
Alarm, LED and Beacons Check	12.3
Maintenance review	17.1

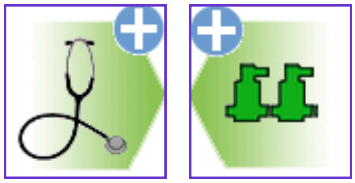
12 Test / Diagnostics

The system test function is available from the top menu screen. This feature allows the system functions to be verified and basic trouble-shooting to be performed. In this mode, the amber LED will flash to indicate the system is in maintenance mode. The system will continue to monitor any active limits to monitor machine safety status if in lift mode. Alarm conditions and warnings / controls will be issued as normal.

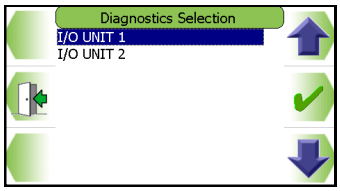

Relay / LED test
Blue lamp, Alarm and display LED test
Display options
Test/Diagnostics Menu 2
Name Sensor Raw Actual Status
Boom Base Piston 178.40 N/A OK
Boom Base Rod 0.00 N/A OK
Boom AS7 69.78 44.10 OK
Arm AS7 34.01 -23.39 OK
Platform Slew -20.00 34.62 OK
Machine Error Status
OK
System information
Code protected access to supervisor features
Exit to previous menu

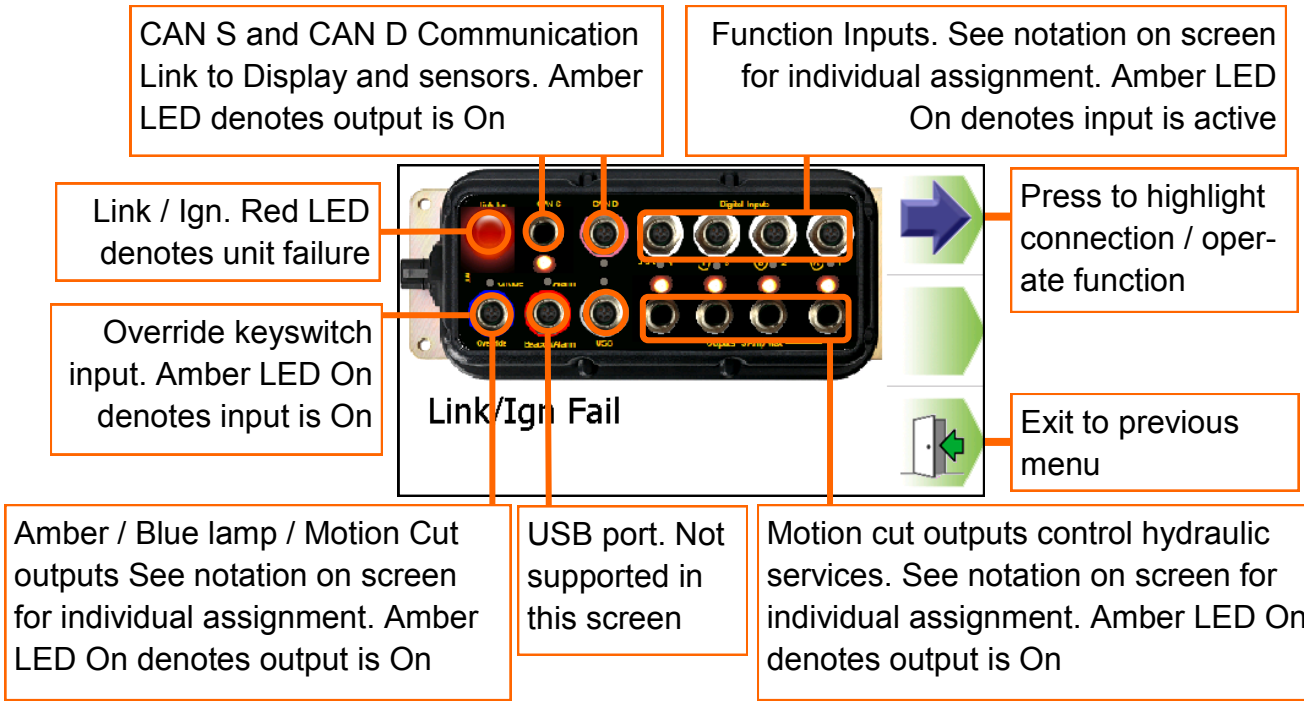
The image shown is an example. The exact contents of the sensor list will depend on machine type and specification.

12.1 Relay Function Test



Select the unit required from the list shown opposite.

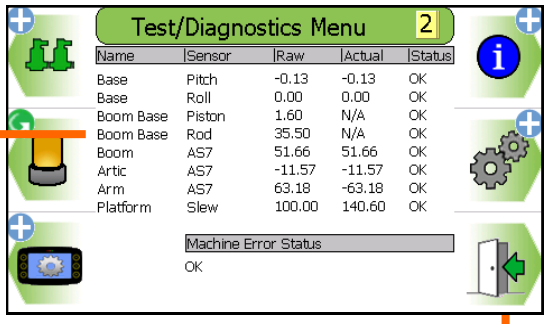



CAN S and CAN D Communication Link to Display and sensors. Amber LED denotes output is On
Function Inputs. See notation on screen for individual assignment. Amber LED On denotes input is active
Link / Ign. Red LED denotes unit failure
Override keyswitch input. Amber LED On denotes input is On
Link/Ign Fail
Press to highlight connection / operate function
Exit to previous menu
Amber / Blue lamp / Motion Cut outputs See notation on screen for individual assignment. Amber LED On denotes output is On
USB port. Not supported in this screen
Motion cut outputs control hydraulic services. See notation on screen for individual assignment. Amber LED On denotes output is On

12.2 Sensor Information

Displays the systems sensor information in bar or degrees. Use the Actual column for direct comparison. The status column shows the health of each sensor.

Base Pitch = Pitch Angle
Base Roll = Pitch Angle
Boom Base Piston = Piston Pressure
Boom Base Rod = Rod Pressure
Boom AS7/10 = Boom angle
Artic AS7/10 = Artic angle
Arm AS7/10 = Arm angle
Platform = Slew angle
Linkage AS7 = Tipping link /Hitch Angle


Test/Diagnostics Menu
2
Name Sensor Raw Actual Status
Base Pitch -0.13 -0.13 OK
Base Roll 0.00 0.00 OK
Boom Base Piston 1.60 N/A OK
Boom Base Rod 35.50 N/A OK
Boom AS7 51.66 51.66 OK
Artic AS7 -11.57 -11.57 OK
Arm AS7 63.18 -63.18 OK
Platform Slew 100.00 140.60 OK
Machine Error Status
OK

Exit to previous menu

12.3 Blue and Amber lamp, Alarm and display LED Function

Press to activate the function in turn.

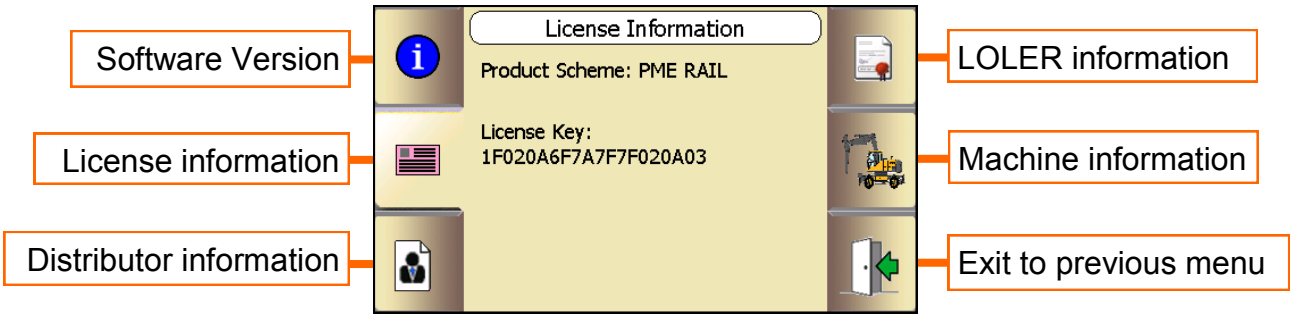
Press the Beacon button to activate the Beacon

Press the Alarm button to activate the blue and amber lamps

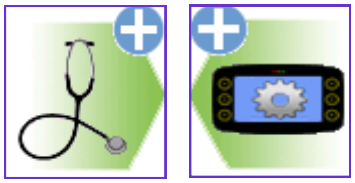
Press the Alarm button to activate the display LEDs

13 System Information

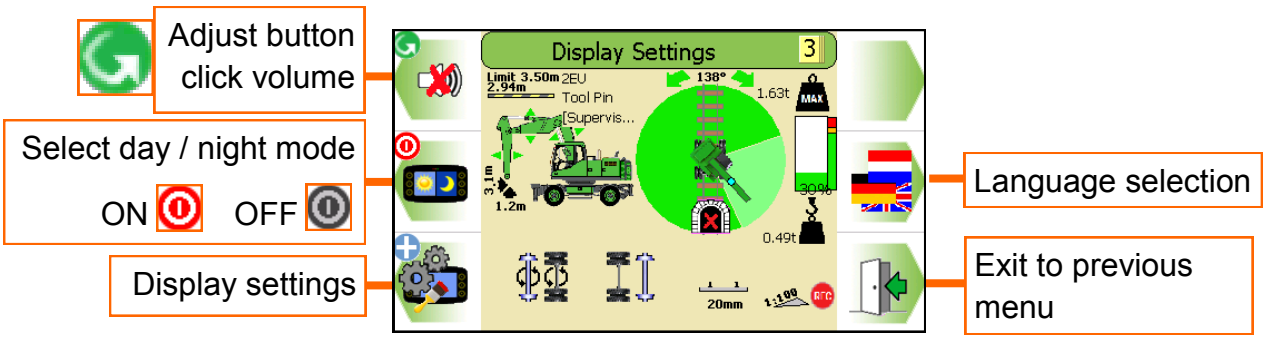
Information regarding the system can be found from this menu.



14 Display Settings Information



The display brightness, button click volume, background colour and the displayed machine can be adjusted from this menu.



14.1 Day / Night Mode

To make viewing of the display more comfortable at night, the display brightness can be switched to a preset ‘night mode’. The system will default to day mode on power up.

Select day / night mode:

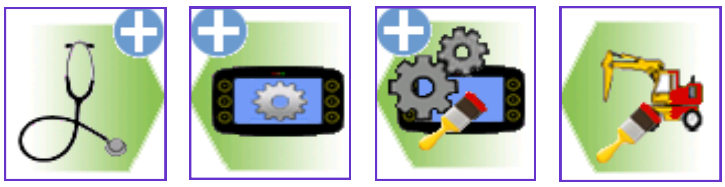
Day mode ON

Full display brightness

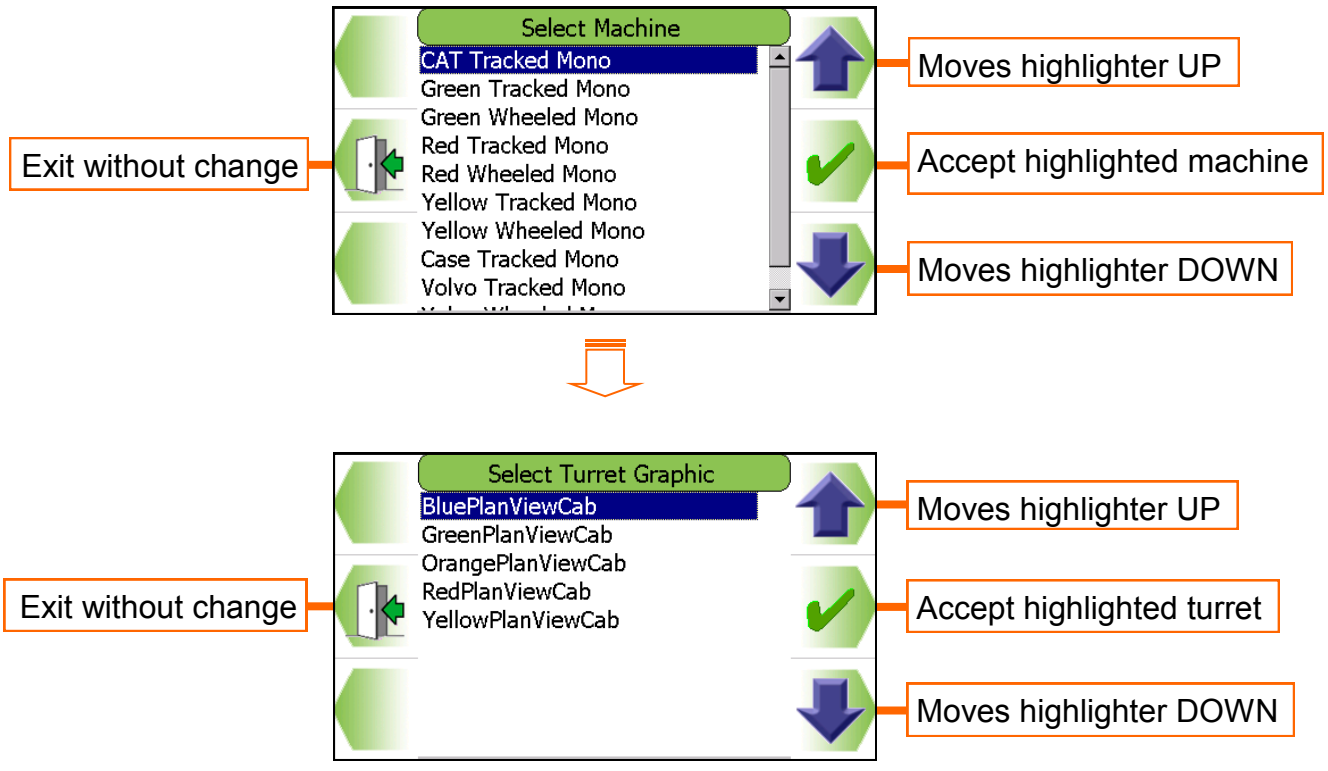
Night mode ON

Reduced display brightness

14.2 Select Display Machine

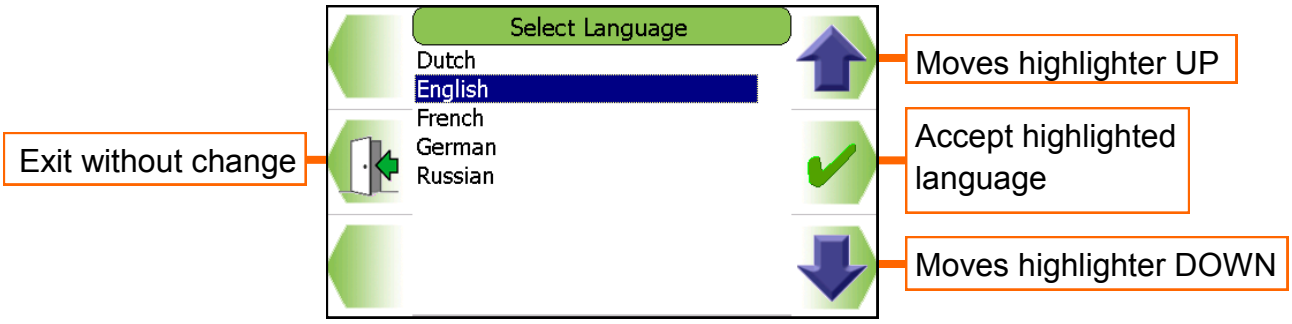


An appropriate machine image for the display can be selected from this list.



14.4 Select Language

Select an appropriate language from the list.

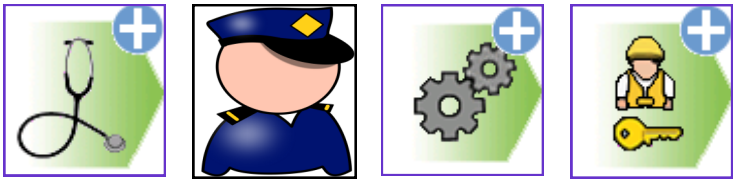


14.5 Select Screen background colour

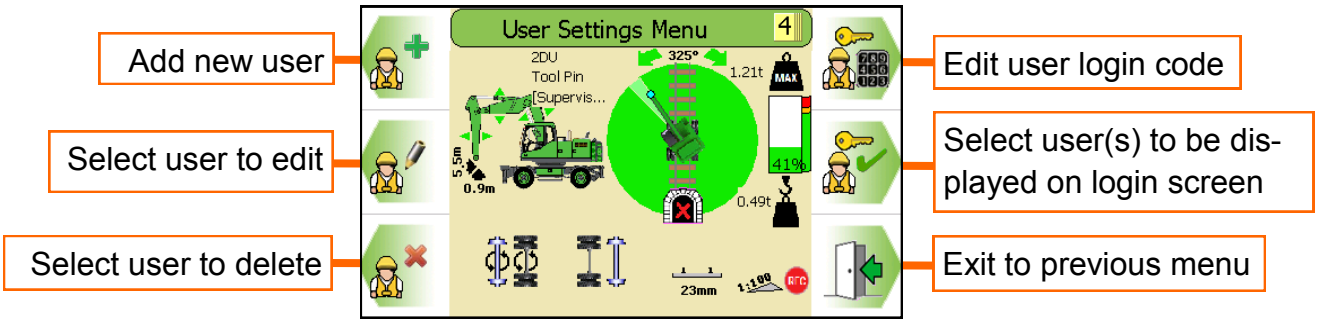
Different background colours, White, blue, cream and grey are available. Use this button to choose as required.

15 User Login

15.1 User Login manual Setup

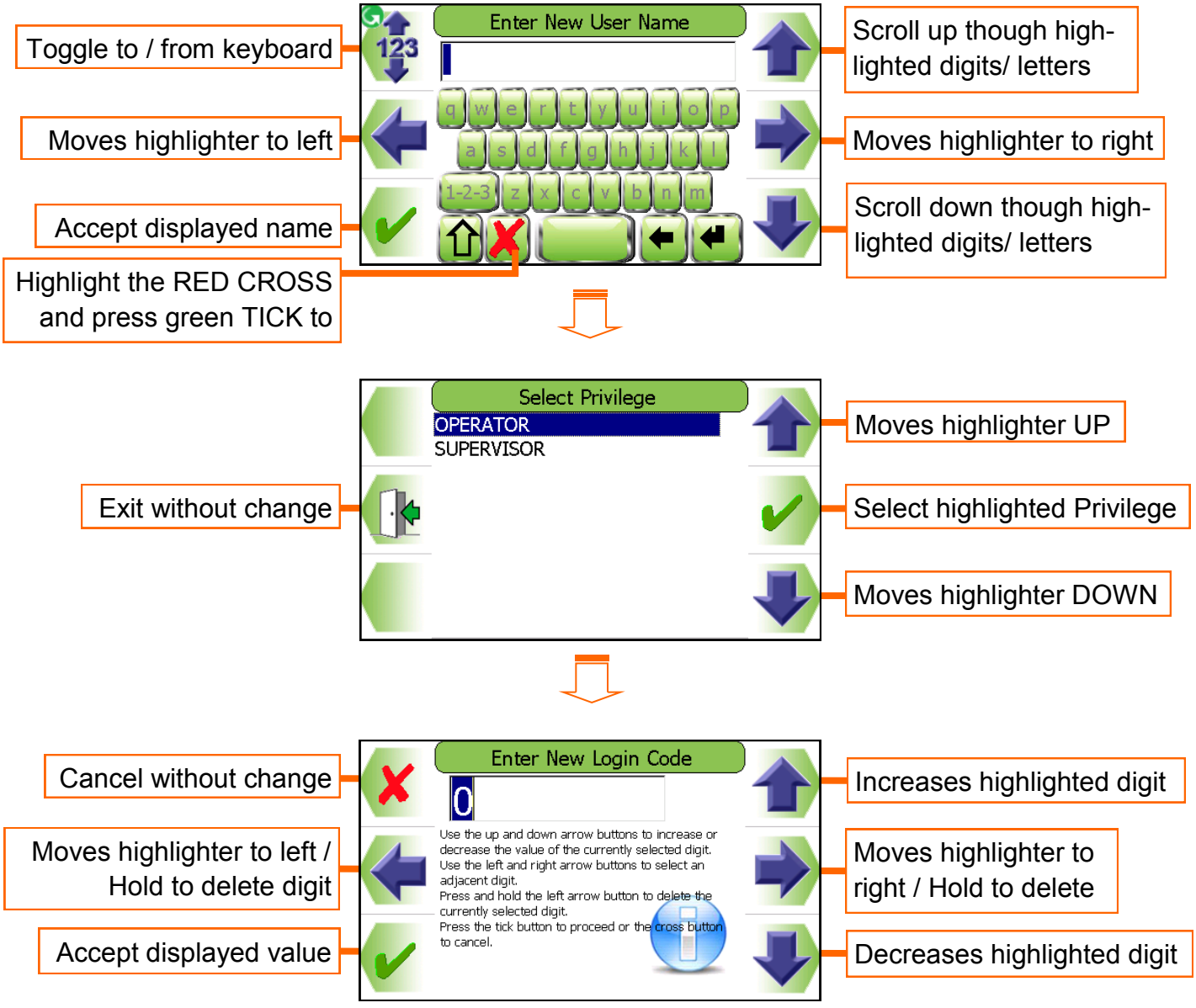


Allows access to edit user details. Requires supervisor access rights.



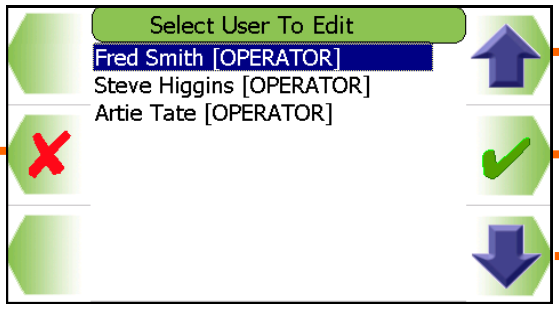
15.1.1 Add New User to Login

Requires supervisor access code


Toggle to / from keyboard
Moves highlighter to left
Accept displayed name
Highlight the RED CROSS and press green TICK to
Enter New User Name
Scroll up though high-lighted digits/ letters
Moves highlighter to right
Scroll down though high-lighted digits/ letters
Select Privilege
OPERATOR
SUPERVISOR
Exit without change
Moves highlighter UP
Select highlighted Privilege
Moves highlighter DOWN
Cancel without change
Moves highlighter to left / Hold to delete digit
Accept displayed value
Enter New Login Code
Use the up and down arrow buttons to increase or decrease the value of the currently selected digit.
Use the left and right arrow buttons to select an adjacent digit.
Press and hold the left arrow button to delete the currently selected digit.
Press the tick button to proceed or the cross button to cancel.
Increases highlighted digit
Moves highlighter to right / Hold to delete
Decreases highlighted digit

15.1.2 Edit User Details

Requires supervisor access rights.

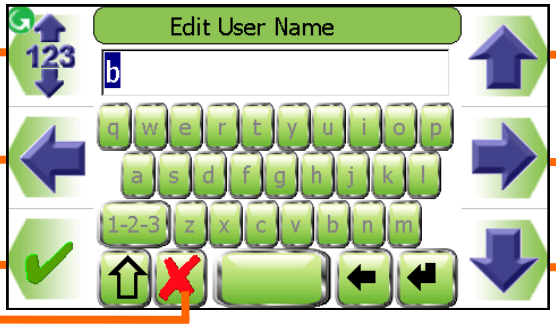


Cancel without change

Moves highlighter UP

Select highlighted user

Moves highlighter DOWN



Toggle to / from keyboard

Moves highlighter to left

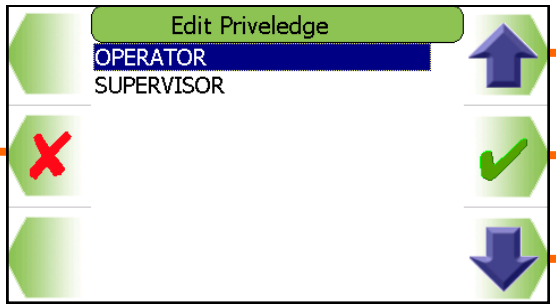
Accept displayed name

Highlight the RED CROSS and press green TICK to exit

Scroll up though high-lighted digits/ letters

Moves highlighter to right

Scroll down though high-lighted digits/ letters

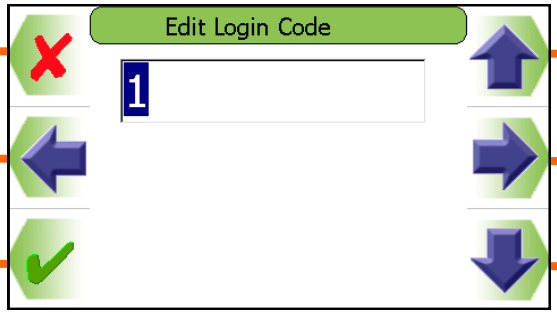


Return to previous screen

Moves highlighter UP

Select highlighted Privilege

Moves highlighter DOWN



Cancel without change

Moves highlighter to right / Hold to delete digit

Accept displayed value

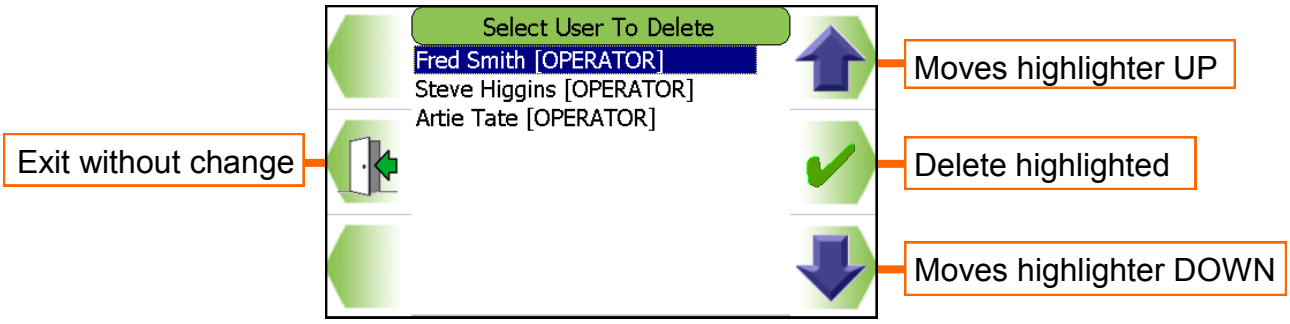
Increases highlighted digit

Moves highlighter to right / Hold to delete digit

Decreases highlighted digit

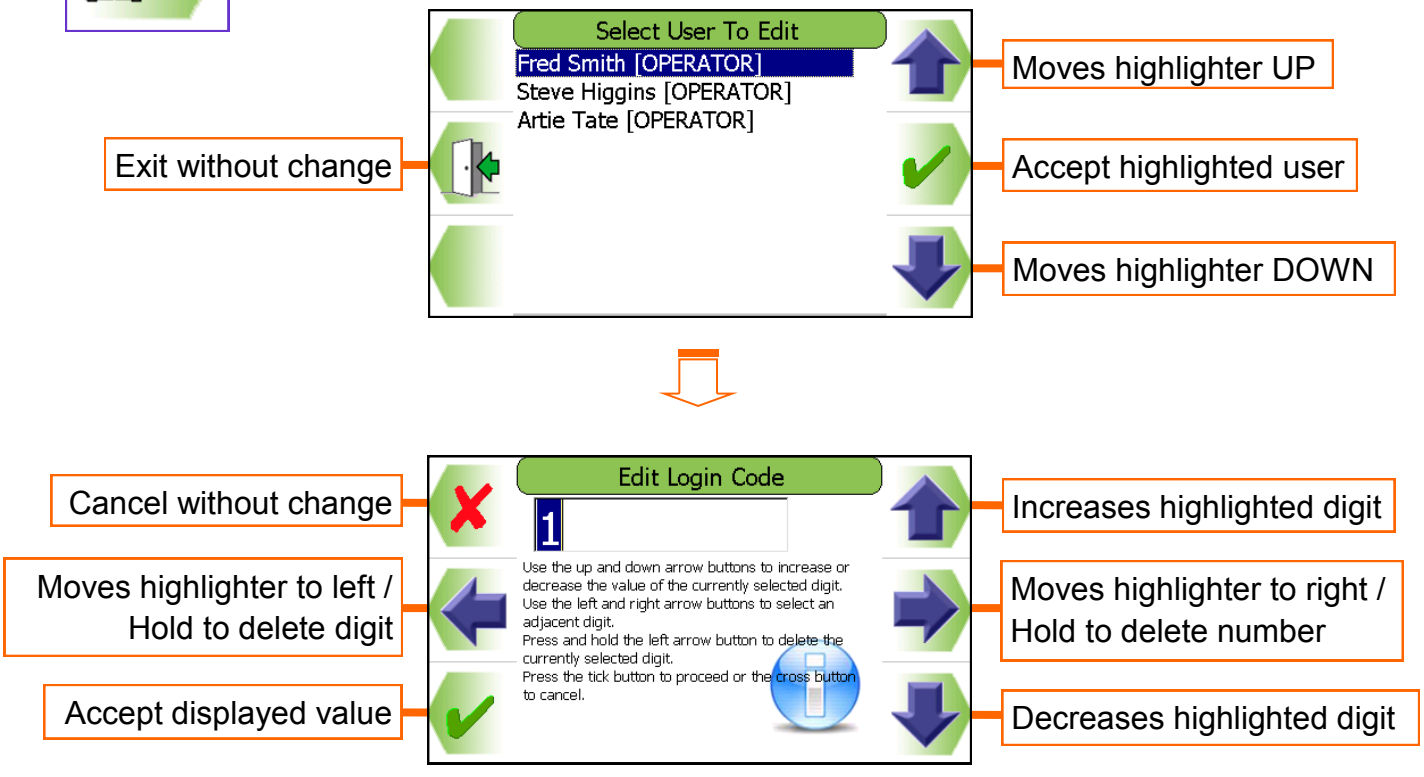
15.1.3 Select User to Delete

Requires supervisor access rights.



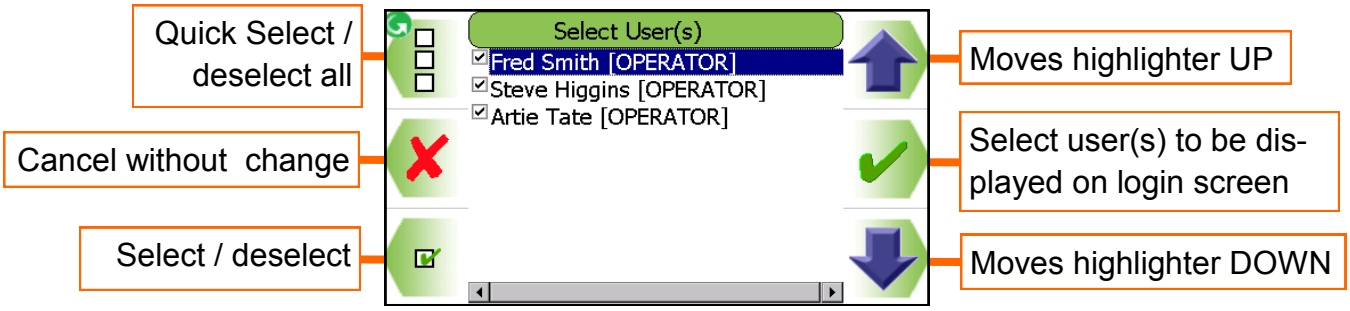
15.1.4 Edit User Login Code

Requires supervisor access rights.

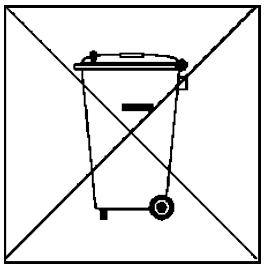

Select User To Edit
Fred Smith [OPERATOR]
Steve Higgins [OPERATOR]
Artie Tate [OPERATOR]
Exit without change
Moves highlighter UP
Accept highlighted user
Moves highlighter DOWN
Edit Login Code
1
Use the up and down arrow buttons to increase or decrease the value of the currently selected digit.
Use the left and right arrow buttons to select an adjacent digit.
Press and hold the left arrow button to delete the currently selected digit.
Press the tick button to proceed or the cross button to cancel.
Cancel without change
Moves highlighter to left / Hold to delete digit
Accept displayed value
Increases highlighted digit
Moves highlighter to right / Hold to delete number
Decreases highlighted digit

15.1.5 Enable / Disable Users

Requires supervisor access rights



16 Taking Product out of Operation



Prolec Limited is committed to complying with the upcoming European Directive of RoHS (Restriction of Certain Hazardous Substances) and WEEE (Waste from Electrical and Electronic Equipment). PME is subject to the WEEE directive, therefore PME or any component must be returned to Prolec Ltd for correct disposal or recycling.
The display and safety controller are fitted with internal batteries and must not be disposed of in landfill.

17 Service and Repair

PMERAIL has very few user serviceable parts. The safety controller / I/O module have internal fuses that can be replaced if required. Section 10 describes daily, monthly and yearly checks that must be carried out to ensure safe operation of the system.

17.1 Maintenance Review

Due to nature of the PMERAIL systems operating environment, changes in usage can occur. Prolec Ltd or the service agreement holder must be notified of any changes in the pattern of use of the system for consideration.
Any alterations or modifications to machine components which affect the system must be reported to Prolec Ltd or via the service agreement holder.
To aid in the use of PMERAIL, all appropriate technical bulletins relating to PMERAIL must be assessed and implemented as appropriate. This information is available from Prolec Ltd.
Prolec Ltd must be informed of any Prolec system component failure. Be it directly or via the service agreement holder.

18 Data Logger

PMERail has two data-logging functions. The data logging icon appearis in the bottom left of the screen. The data can only be viewed by extracting it from the system, contact your service agreement holder or Prolec Ltd for further assistance.

Where a data logging system is found not to be operational then the vehicle shall not be used until the fault is repaired and fully confirmed as operational. This requirement applies irrespective whether starting or partway through an operation.

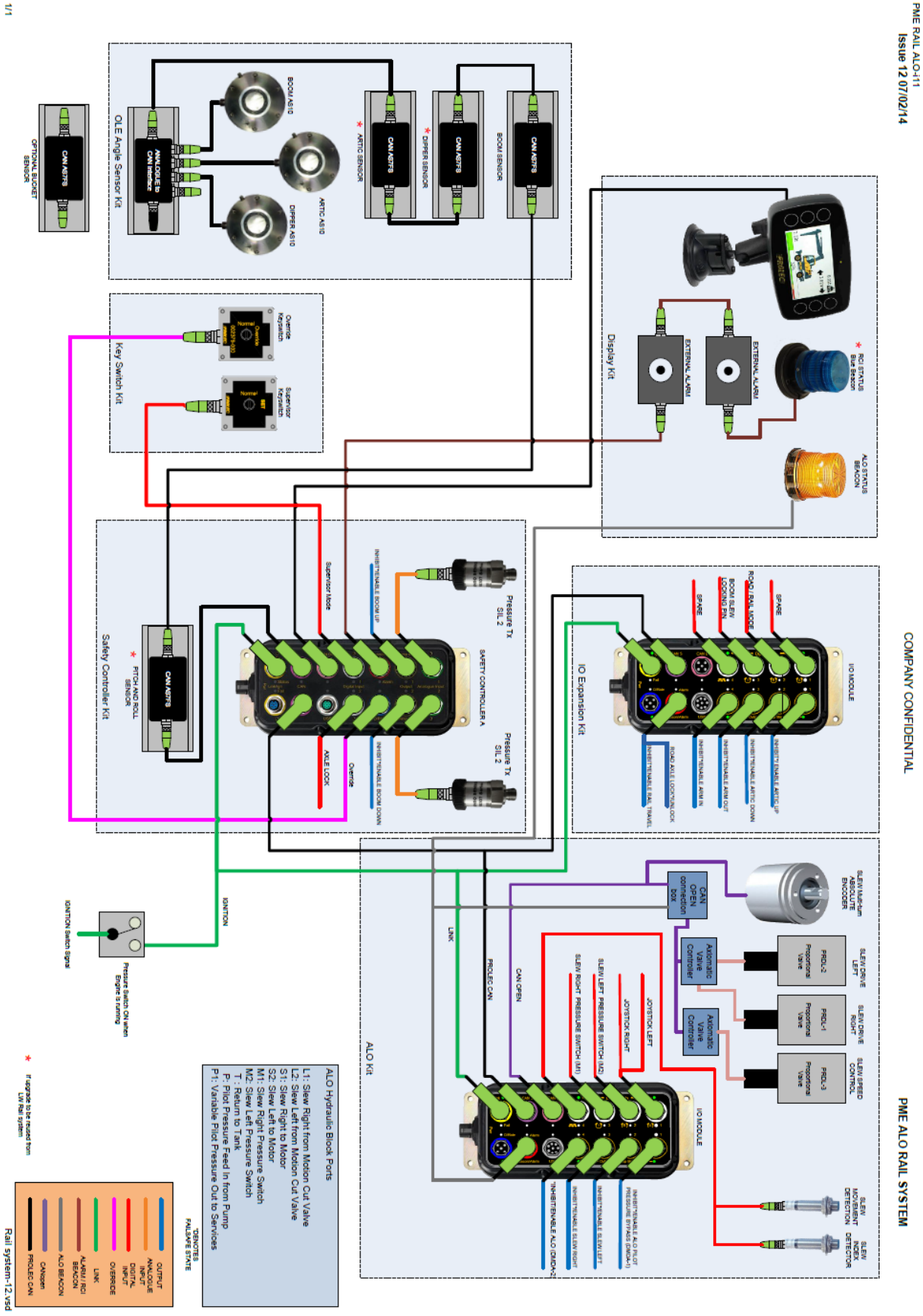
1. The **Event Logger** will make a record of any significant operational event (overload, slew limit, etc), any error event (sensor failure etc), any manual intervention (override, clock set etc) and any activity within the system set-up (calibration adjustment etc). The event logger will store the past two months worth of data after which the oldest data will be deleted on a monthly basis.

2. The **Periodic Logger** records the following data every 1 second:

Date	Time
Lifting duty	Load on hook
Lift point radius	Lift point height
Slew angle	Cant
Gradient	Operator code

The event logger will store the past two months worth of operational hours data, (NOT elapsed time) after which the oldest data will be deleted on a monthly basis.

19 System Diagram



20 Definitions / Glossary

Definitions of words used to ensure understanding

P/N	Part Number
Boom	First articulation connected to turret
Arm	Second articulation
Artic	Second articulation of a hydraulically adjustable boom (luffing boom, knuckle boom, two piece boom)
Turret	Section of machine above the undercarriage
Undercarriage	Section which the tracks/wheels attach too
Track	continuous band of treads, metal or rubber covered
Wheeled excavator	An excavator fitted with wheels
Tracked excavator	An excavator fitted with tracks, also known as
Bucket	Digging attachment
Attachment	Tool fixed to the dipper other than a bucket
SC	Safety Controller
MMI	Man Machine Interface (i.e. Display)
CAN cable	Cable connecting system components
Angle sensor	Sensor detecting current equipment angle
Pitch	Longitudinal base machine angle (fore / aft) / Gradient
Roll	Lateral base machine angle (side to side) / Cant
Motion Cut	Direct control of component hydraulic service
Power Supply	DC supply voltage
Ram	Hydraulic Cylinder
Blade	heavy metal plate on the front of the machine, used for stability and moving material
Stabiliser	Hydraulically powered arms that can be lowered and raised to increase the Stability of the machine
Counterweight	Weight attached to the rear of an excavator to increase digging force and lifting capacity
Pivot pin	Point at which the articulations rotate about
Relay	Electronic device to operate motion cut valve
Offset Boom	Boom that pivots part way along or at it fixing point to the turret

Appendix 1 Duty Numbering

The duty number is made up of three values: Road/rail cant - active sector - Axle lock status i.e. 2BL will be rail (0-50mm cant), sector B, Axles Locked.

Road/Rail Cant Levels

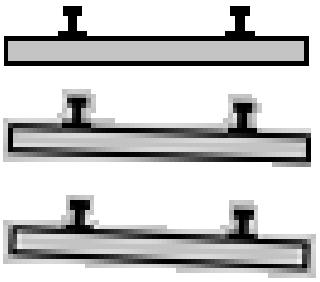
The cant levels shown here are the default values. These can be adjusted as required during calibration. Cant measurement shown refers to the machine turret.

1 Road

2 Rail between 0-50mm cant

3 Rail between 50-150mm cant

4 Rail between150-250mm cant (Default)



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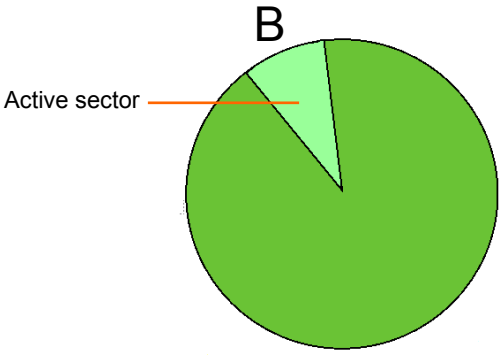
Active Sector

Duty sectors originate from from 0° slew (over floating axle) and can contain sectors from **a**-**r.** Each duty block (i.e. Road, Rail 0-50mm cant etc) can have different configurations of sectors. Only the current sector is shown on the display.



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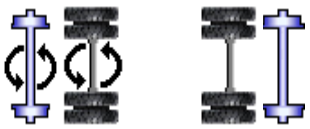
Axle Lock Status

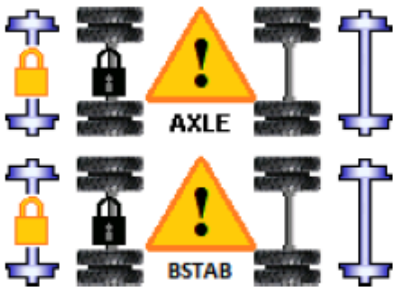
Axle status forms the last part of the duty number. Locked axle are labelled **L**, floating axle **U**. Tracked machines have no floating / locked road duties.

	Wheeled		**Tracked**	
	Floating	Locked	Floating	Locked
Road			N/A	N/A
Rail				

Appendix 2 Interlocks

1. When the oscillating rail axle is locked the symbol shown here will appear on the display. If the interlock was configured during installation the forward and rear travel functions will be disabled when this symbol is visible.

2. When the oscillating rail axle is locked, PMERail will start to monitor the equivalent UNLOCKED duty. If either the lift capacity or the backward stability level of the UNLOCKED duty is unsafe, the YELLOW 'padlocks' will be shown on the display. If the interlock was configured during installation, the axle lock control will be disabled preventing the axle from being unlocked. Wheeled example shown.



The display will automatically revert back the top menu screen after ten seconds if a button has not been pressed.

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